# MECHANICAL ENGINEERING

February 1956

in this issue

Developments in Instrumentation by the Petrochemical Industry . . . . . R. G. Marvin, W. L. Stuart, G. W. Lunsford, and E. E. Ludwig 132

How to Improve Profits—A Challenge to Engineering . . . . . K. L. Block 135

Process Control by End-Point Analysis . . . . S. M. Rock and Jack Walker 137

Field-Testing a Reversible Pump-Turbine . . . F. E. Joski 141

Consumable-Insert Technique for Pipe Welding . . . . . R. D. Thomas, Jr. 145

Some Major Findings of the Hoover Commission . . . . . S. C. Hollister 150

A Role for Student Professional and Honorary Societies in Engineering Education . . . R. C. Dean, Jr. 154

DEPARTMENTS

Editorial . . . . . 131
Briefing the Record . . 156
European Survey . . . 168
ASME Technical Digest . 170
Comments on Papers . . 180
Reviews of Books . . . 182
ASME Boiler and Pressure Vessel Code . 185
ASME News . . . . . 187
Keep Informed, Adv. p. . 43

ASME Spring Meeting • Portland, Oregon • March 18-21, 1956

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about

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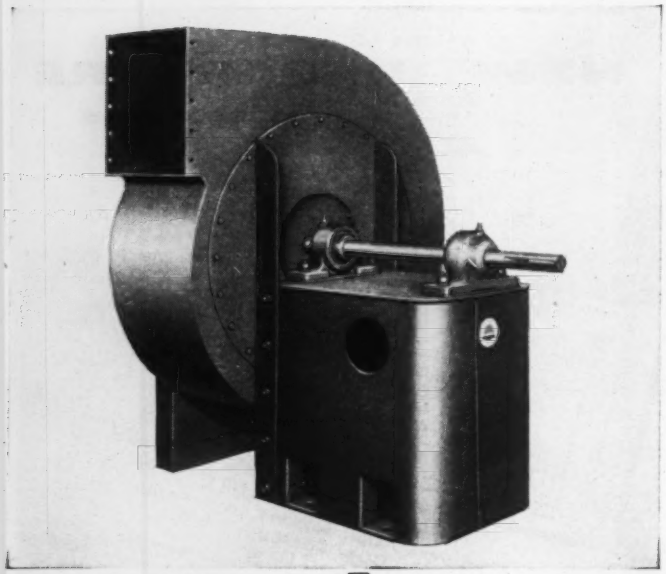
## NEW FEATURES! HIGHER EFFICIENCIES! NEW "3-IN-1" DESIGN!

# AMERICAN BLOWER SERIES 106 INDUSTRIAL FAN



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Certified ratings! Pressures to 18" w.g.! Volumes to 125,000 cfm! Heavy construction! Choice of 3 special-duty wheels! You get all these features, and many more in American Blower's new Series 106 Industrial Fans.

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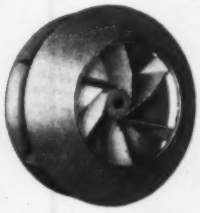
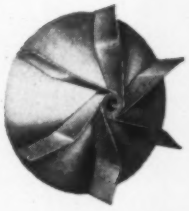
**Air Handling** – for efficient handling of air, fumes, or gases – either clean, or containing light concentrations of dust or materials.



**Material Handling** – efficiently handles air or gases containing granular material – dust grain, exhaust from buffing or grinding wheels.



**Long Shavings** – specially designed for conveying or handling air or gases containing long stringy material – wood shavings, fibers, alfalfa.

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Blow-Off Valves–
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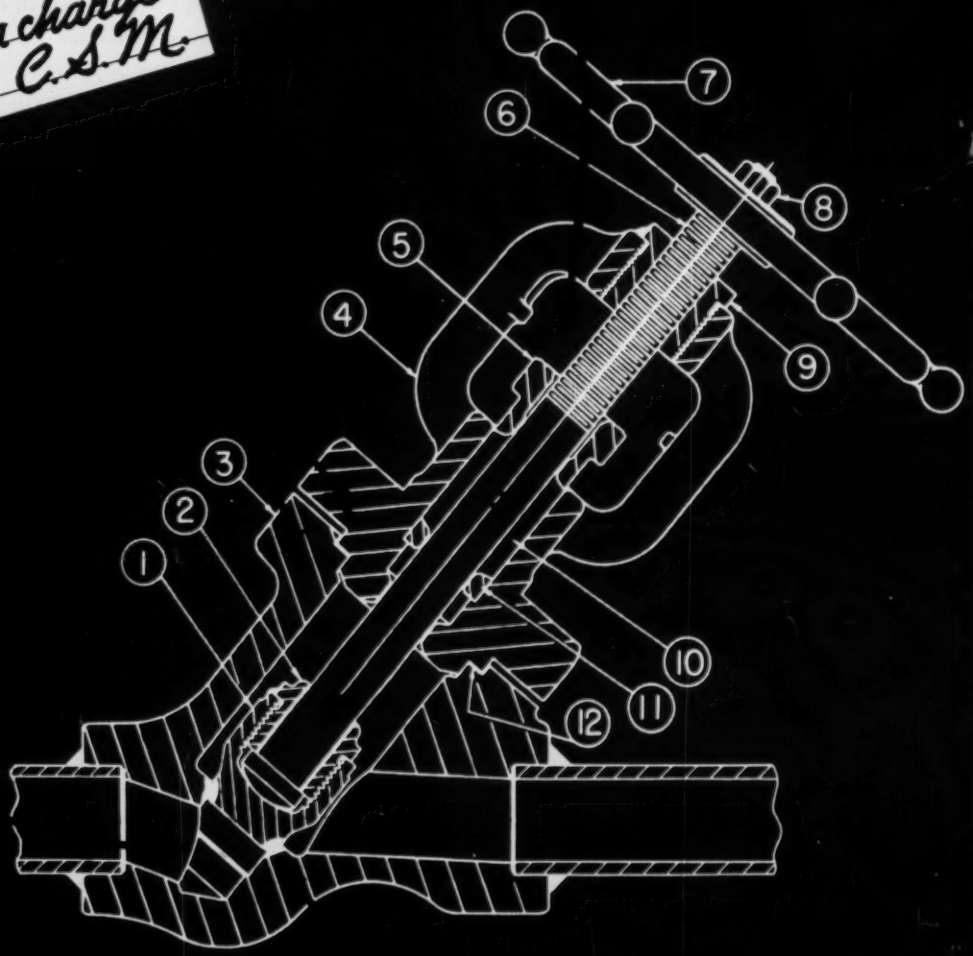


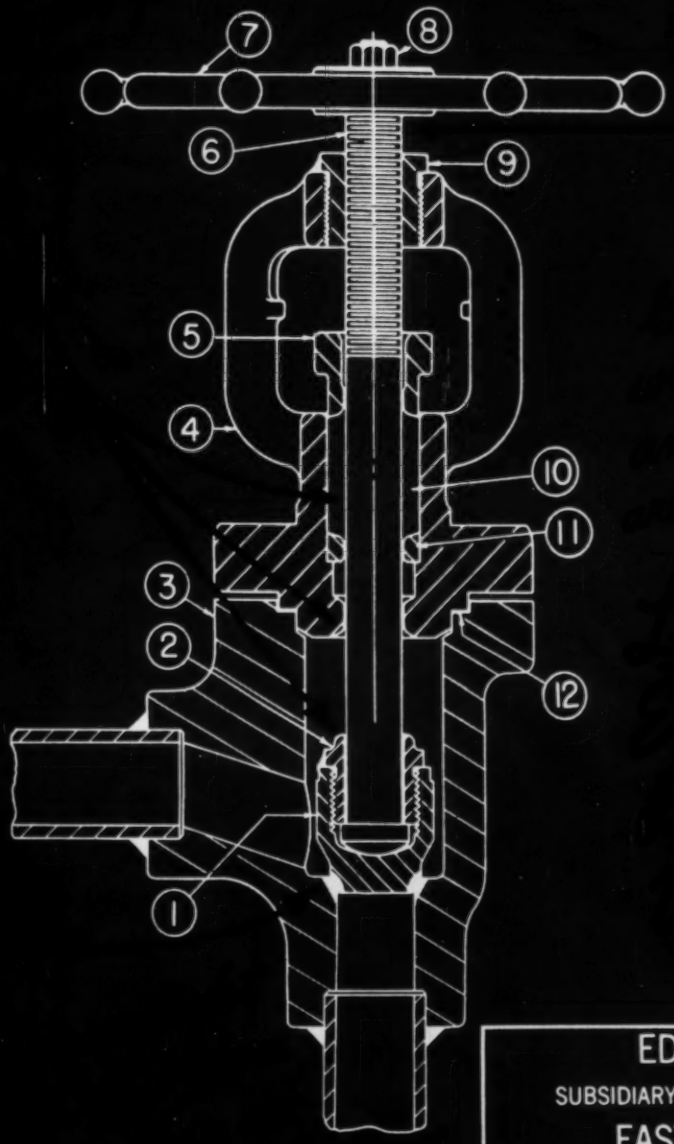

LIST OF MATERIAL

QUANTITIES ARE FOR 1 STRAIGHTWAY OR 1 ANGLE VALVE

WHERE A.S.T.M. SPECIFICATIONS ARE INDICATED THE LATEST REVISION APPLIES

| PIECE NO. | NAME OF PIECE | NO. REQ'D | MATERIAL | SPECIFICATIONS | EDWARD MS NO. |
|---|---|---|---|---|---|
| 1 | DISK | 1 | FORGED ALLOY STEEL WITH | A.S.T.M. A182 GRADE F11 STELLITED SEATING FACE | 227 483 |
| 2 | DISK NUT | 1 | STEEL | A.I.S.I. G1120 | 123 |
| 3 | BODY | 1 | FORGED STEEL WITH | A.S.T.M. A105 GRADE II STELLITED SEATING FACE | 111 483 |
| 4 | BONNET | 1 | FORGED STEEL | A.S.T.M. A105 GRADE II | 111 |
| 5 | GLAND | 1 | MALLEABLE IRON | A.S.T.M. A220, GRADE 53004 | 324 |
| 6 | STEM | 1 | EVALLOY | A.I.S.I. GRADE 416 | 261 |
| 7 | HANDWHEEL | 1 | MALLEABLE IRON | A.S.T.M. A47 GRADE 32510 | 322 |
| 8 | STEM NUT | 1 | STEEL | A.S.T.M. A194 - CLASS 1 | 124 |
| 9 | YOKE BUSHING | 1 | BRONZE | A.S.T.M. B62 | 412 |
| 10 | PACKING RINGS | | EVALPAK | HIGH TEMPERATURE PACKING | 501 |
| 11 | JUNK RING | 1 | STEEL - EVALIZED | A.I.S.I. G1120 | 123 |
| 12 | BONNET GASKET | 1 | IRONKOTE | ARMCO IRON 90 BHN. MAX. | 505 |
| 13 | GLAND BOLT WASHER | 2 | STEEL | | |
| 14 | GLAND BOLT | 2 | FORGED STEEL EVALIZED | A.S.T.M. A105 GRADE II | 111 |
| 15 | GLAND BOLT NUT | 2 | STEEL-EVALIZED | A.S.T.M. A194 - CLASS 0 | 125 |
| 16 | TAP END STUD | 4 | ALLOY STEEL | A.S.T.M. A193 GRADE B7 | 208 |
| 17 | BONNET STUD NUT | 4 | STEEL | A.S.T.M. A194 - CLASS 1 | 124 |

**ROCKWELL-BUILT**
**EDWARD STEEL VALVES**

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| | | |
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| CHK'D. [illegible] | | AE-3664-1 |
| APPD. [illegible] | DATE 8-29-55 | |

Edward builds Globe and Angle Stop, Non-Return, Stop-Check, Check, Gate, Blow-Off, Mudline, Relief, Hydraulic, Instrument, Gage, and Special Valves and Strainers.

# 50-ton crane becomes 85-ton crane

## *with no increase in size*

United States Steel's Edgar Thomson Works in Braddock, Pennsylvania, needed new and heftier crane equipment to handle larger ladles. One of the requirements was four new crane trolleys which were to operate on the same bridges, if possible, and in exactly the same clearances as before.

The trolleys had to be stronger but no larger than before; so ordinary steel wouldn't do. Needed, was a steel of *exceptional strength* which could be *welded easily*. Lots of alloy steels could have met the strength requirements; but USS "T-1" Steel was the *only* steel that could supply not only the required strength, but good weldability as well.

"T-1" Steel plate—in ¾" and 1" thicknesses—was used in box girders and lateral stiffener plates of the trolleys. This change increased the crane capacity from 50 to 85 tons with no increase in size.

The structure was welded with AWS E12015 electrodes. It was as easy as welding carbon steel. No stress relief was needed. And the welds developed the full yield strength of the steel: 90,000 psi. minimum.

Remember this story when you must weld very high strength parts—parts that must operate at temperatures as high as 900°F. or as low as 40°F. below zero, parts that must withstand tremendous impact abuse, abrasion, or tensile stress. Then consider USS "T-1" Steel. We'll gladly send you full particulars. Just write to United States Steel, Room 4765, Pittsburgh 30, Pa.

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**USS "T1" CONSTRUCTIONAL ALLOY STEEL**

USS

UNITED STATES STEEL

# UNION ELECTRIC adds

## Unit No. 3 at MERAMEC STATION will be served by a Foster Wheeler twin furnace, dual circulation, differentially fired, reheat steam generator of 1,850,000 lb/hr capacity

WITH the addition of this 275,000-kw Unit No. 3 at Meramec Station, Union Electric Company of Missouri will boost total station capacity to 560,000 kw, keeping well ahead of anticipated load growth.

The new turbine will be served by an FW steam generator with a maximum continuous capacity of 1,850,000 pounds steam per hour, 2150 psig at the superheater outlet, 1010F/1010F. This unit is unique in that it combines twin furnace arrangement, dual circulation and reheat—three major advances in modern, large capacity steam generator design. The selection of this combination is a gratifying expression of confidence in the efficiency and dependability of Foster Wheeler steam generating equipment.

The twin furnace design, a Foster Wheeler development, provides sufficient water-cooled and steam-cooled areas to prevent slagging of boiler and superheater surfaces. The use of combination radiant and convection surfaces for superheating, plus differential firing, permits constant final and reheat steam temperatures over a wide operating range, stabilizing steam conditions for maximum turbine efficiency.

Dual circulation, another Foster Wheeler development, has been incorporated as insurance against potentially troublesome silica deposition in the turbine.

Coal for the differential-fire-controlled furnaces will be pulverized in three Foster Wheeler Ball Mills.

The proved dependability and long-range economy of Foster Wheeler steam generators are backed by more than 50 years of experience in pioneering power plant equipment. We will be pleased to quote on your requirements. *Foster Wheeler Corporation, 165 Broadway, New York 6, N. Y.*

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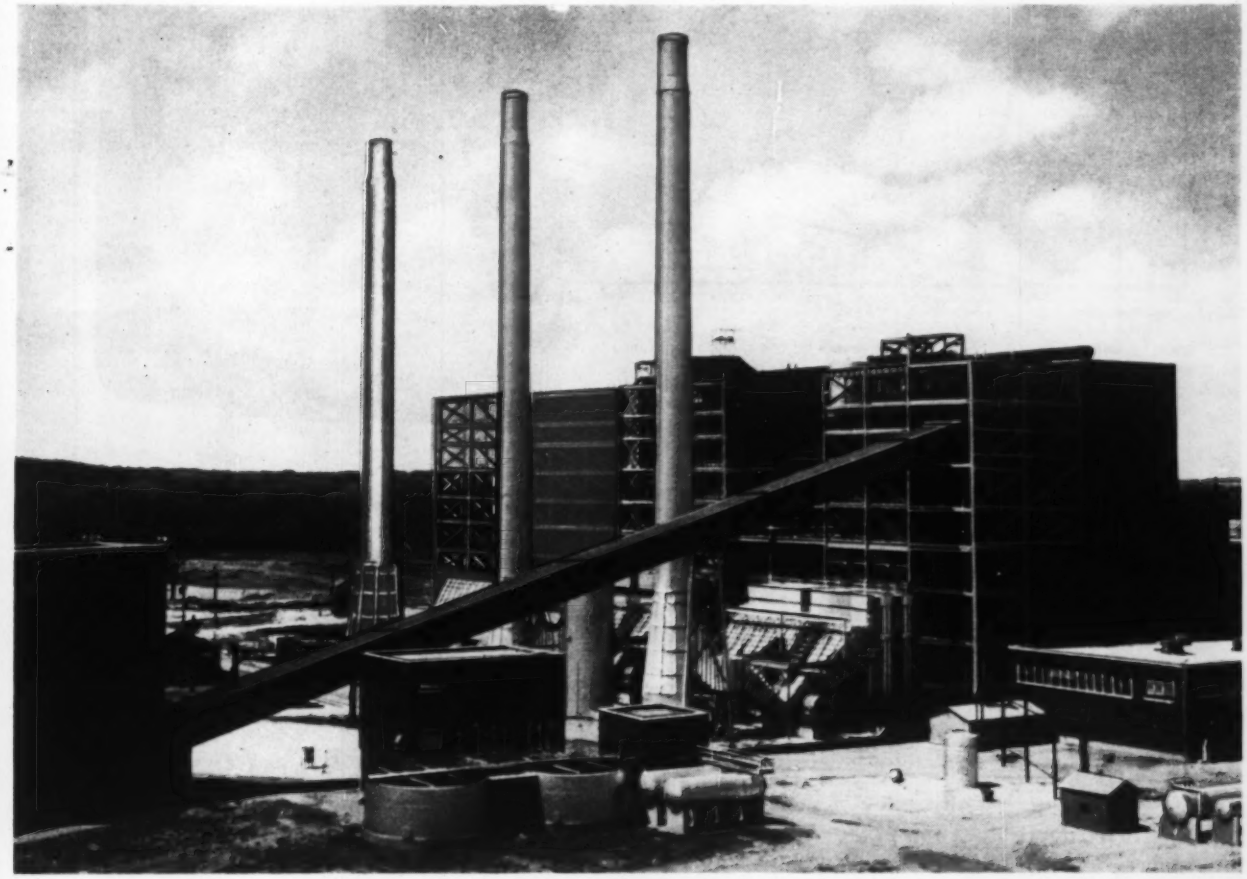
**SURFACE CONDENSERS**
**FEEDWATER HEATERS**
**HEAT EXCHANGERS**

# FOSTER

NEW YORK • LONDON

# 1,850,000 lb steam per hr!



The above photograph of Union Electric's Meramec Station shows, in color, the new Unit No. 3 as it will appear when the addition is completed in 1958. With a capacity of 275,000 kw, Unit No. 3 will increase the total output of Meramec Station to 560,000 kw. keeping system capability well ahead of maximum anticipated load growth.

Reddy Kilowatt

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# WHEELER

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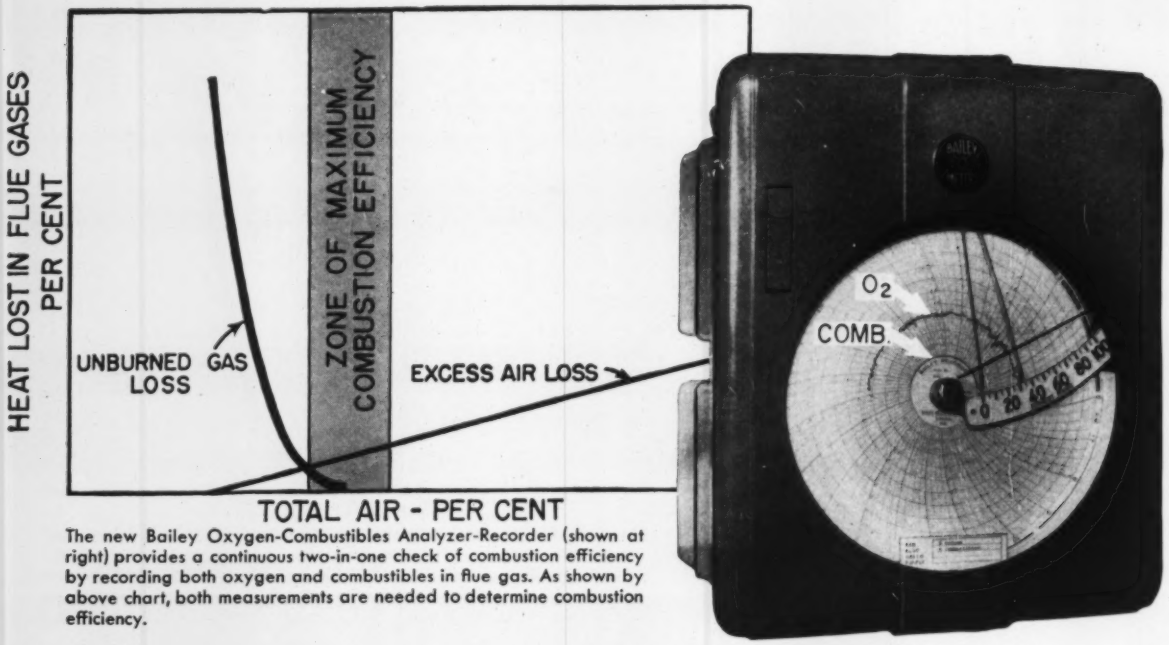
**ECONOMIZERS**
**BALL MILL PULVERIZERS**
**COOLING TOWERS**




The new Bailey Oxygen-Combustibles Analyzer-Recorder (shown at right) provides a continuous two-in-one check of combustion efficiency by recording both oxygen and combustibles in flue gas. As shown by above chart, both measurements are needed to determine combustion efficiency.

# BAILEY announces . . .
# New 2 in 1 way to measure Combustion Efficiency

**The new Bailey Oxygen-Combustibles Analyzer-Recorder gives you a continuing double check on combustion economy. It's fast response measures and records:**

**1. Excess air**—regardless of the fuel or combinations of fuels being burned.

**2. The mixing efficiency of your fuel-burning equipment**—by indicating the amount of combustibles in your flue gas, resulting from incomplete mixing of fuel and air.

Combustion efficiency depends upon fuel-air ratio. Too much fuel can be even more costly than too much air. And because of the interdependence of these two factors, no control that measures only one of them can give you complete protection.

Now, for the first time, you can check *both* with a *single* fast acting instrument, using the new Bailey Oxygen-Combustibles Analyzer-Recorder for industrial furnaces, kilns, heaters and boilers.

Fuel economy improves as excess air is reduced —until unburned fuel begins to show up in the flue gas. When this happens, combustion efficiency drops off sharply if there are further decreases in the air-fuel ratio. That's why combustion gases must be analyzed for *both* oxygen and combustibles to get a true indication of efficiency—and that is why Bailey coordinates both measurements on the same chart, to show when excess air may be reduced safely without danger of greater losses from unburned gases.

The Bailey Oxygen-Combustibles Analyzer is an approved combustion safeguard.

Ask your local Bailey engineer for suggestions on application. Equipment details in Product Specifications E65-1 and E12-5. P31-1

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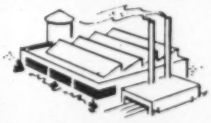
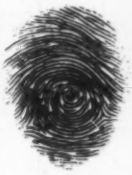


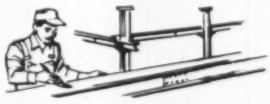
**PROVED THROUGHOUT INDUSTRY FOR OVER THIRTY YEARS**

Industrial leaders all over the world have used Rust-Oleum to stop and prevent rust for over thirty years. Rust-Oleum can do the same for your tanks, stacks, pipes, machinery, metal sash, wire fences, girders, etc.

**RUST-OLEUM IS EXCLUSIVE**



Rust-Oleum uses a specially-processed fish oil vehicle that penetrates rust to bare metal, dries right, and is free from objectionable odor. Accept no substitutes. Buy—and specify Rust-Oleum. You'll be happy that you did. There is only one Rust-Oleum—it is distinctive as your own fingerprint.



**APPLY DIRECTLY OVER RUSTED SURFACES**

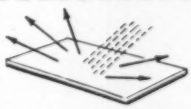
Just scrape and wirebrush to remove rust scale and loose rust—then brush Rust-Oleum 769 Damp-Proof Red Primer right over the remaining rust, usually eliminating costly surface preparations. Then—follow-up with your desired Rust-Oleum finish color.

**MANY COLORS, INCLUDING ALUMINUM AND WHITE**

You beautify as you protect, because Rust-Oleum finish coatings are available in practically all colors, including aluminum and white. They use the same basic rust-inhibiting vehicle as Rust-Oleum 769 Damp-Proof Red Primer and so provide double protection.

**GREATER COVERAGE—EASY TO USE**

Rust-Oleum is so easy to apply by brush or spray that one man can often do the work of two. Because of Rust-Oleum's easy-flowing qualities, an average of 30% more coverage is usually received—depending upon the type and porosity of the surface.



**PRACTICAL ANSWER TO YOUR RUST-PRODUCING CONDITIONS**

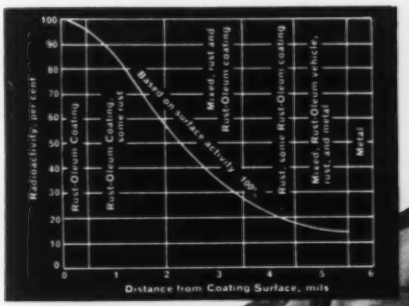
Rust-Oleum dries to a firm, decorative finish that resists salt water, heat, fumes, sun, steam, humidity, and weathering. Whatever your rust problem—you'll find Rust-Oleum the modern, practical way to stop rust.

# Facts

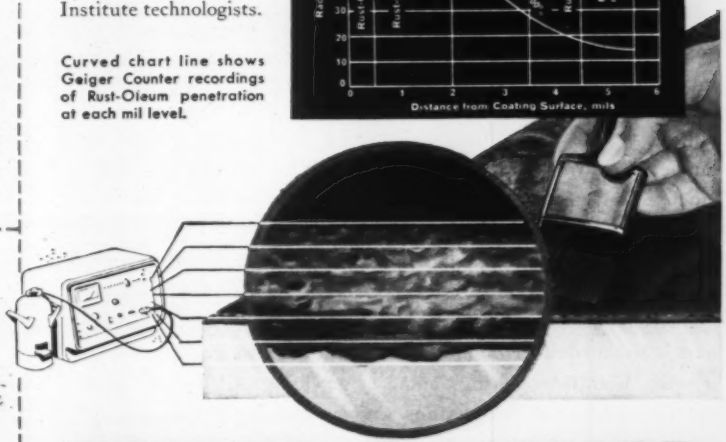
**prove the economy of**

# RUST-OLEUM®

**Geiger Counter traces Rust-Oleum penetration through rust to bare metal.** The results of radioactive research prove that Rust-Oleum penetrates rust to bare metal. Rust-Oleum's *specially-processed* fish oil vehicle was radioactivated and formulated into Rust-Oleum 769 Damp-Proof Red Primer—then applied to rusted test panels. Geiger Counters then traced Rust-Oleum's *specially-processed* fish oil vehicle through the rust to bare metal. This penetration enables Rust-Oleum to be applied directly over sound rusted surfaces—usually eliminating costly surface preparations. Attach coupon to your business letterhead for your thirty-page report, "The Development of a Method To Determine The Degree of Penetration of a Rust-Oleum Fish-Oil-Based Coating Into Rust On Steel Specimens," prepared by Battelle Memorial Institute technologists.




**Curved chart line shows Geiger Counter recordings of Rust-Oleum penetration at each mil level.**



# RUST-OLEUM®

# STOPS RUST!

See our Catalog in SWEETS, or write for complete information. Prompt delivery from Industrial Distributor stocks.

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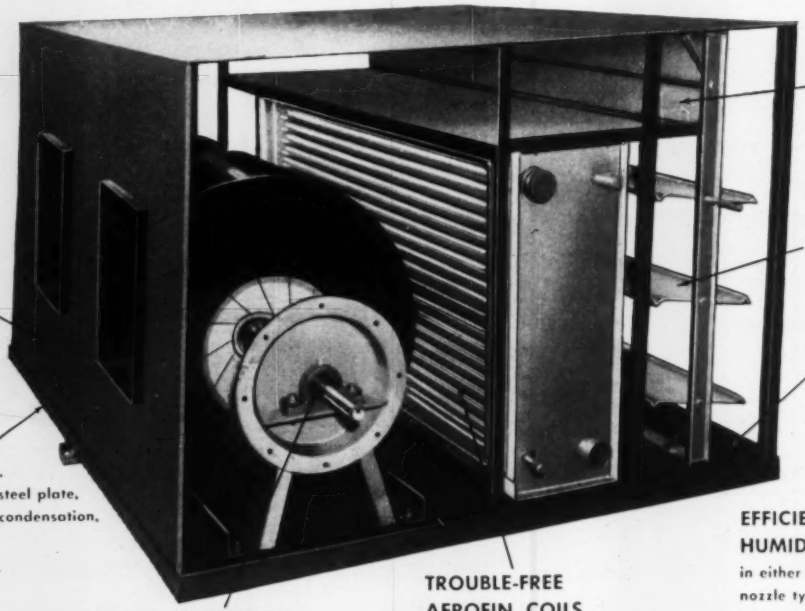
- ☐ Complete literature with color charts.
- ☐ Thirty-page report on Rust-Oleum penetration.
- ☐ Nearest source of supply.

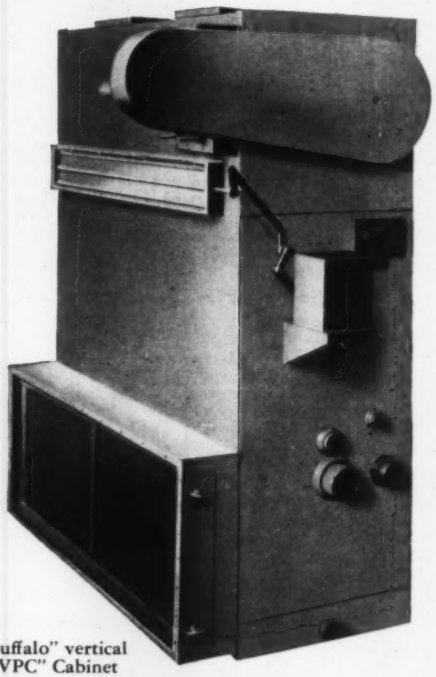



# "BUFFALO" PC AIR CONDITIONING CABINETS DESIGNED WITH ONE GOAL:

## *Customer Satisfaction**

. . . and satisfaction is what these Cabinets are giving. The reasons are evident in the cutaway model above: quality designed into every part. Their built-in "Buffalo" mixed-flow fans are much more efficient than forward curve wheels and can be operated at high speeds and pressures with very low noise level. Their performance is highly stable. This sturdily constructed horizontal model can be placed directly on the floor or installed overhead. Available also in vertical "VPC" models with standardized sectional construction for easy moving thru standard building openings, and easy servicing. All models may be had with air washer sections. Capacities from 875 to 22,000 cubic feet of conditioned air per minute. Write for Bulletin AC120 for details.

**The "Q" Factor — the built-in Quality which provides trouble-free satisfaction and long life.*



"Buffalo" vertical "VPC" Cabinet

**BUFFALO FORGE COMPANY**

BUFFALO, NEW YORK

Canadian Blower & Forge Co., Ltd., Kitchener, Ont.

VENTILATING AIR CLEANING AIR TEMPERING INDUCED DRAFT EXHAUSTING FORCED DRAFT COOLING HEATING PRESSURE BLOWING

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This Blue Sheet contains certified data on the physical characteristics of Ottawa 60, prepared from carefully checked laboratory and field service tests. All the information you'll need on methods of handling and heat treatment, etc.
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OTTAWA 60 is a *new* die steel, an A-L "original," developed primarily to deep draw and form stainless steel. As intended, it performs without galling or pickup and shows exceptional wear resistance in that service. We have plenty of case histories to show you in proof.

But *wherever* you use Ottawa 60 draw dies—not just on stainless steel—this high-carbon, high-vanadium alloy comes through for you. Illustrated above are the first and second draws on transformer housings, produced from .037″ gauge SAE 1010 strip. The company formerly used dies made of 5% chrome air-hardening die steel—and later a more highly alloyed material—without ever getting more than about 2000 pieces before the dies began to show gall marks and pickup, and parts were rejected due to scoring, breakage and oversize. *Dies made from Ottawa 60 forgings cured that! Results after 25,000 pieces showed no pickup and no wear on punch or die.*

● You can solve many a problem and save real money with Ottawa 60 draw dies! Write for information or call in our Field Service Staff to help you get started.

***Allegheny Ludlum Steel Corporation, Oliver Building, Pittsburgh 22, Pa.***

For complete **MODERN** Tooling, call

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WAD 5483

AL® FINE TOOL STEELS SINCE 1854

# Cylindrical Roller Bearing Retainers . . .

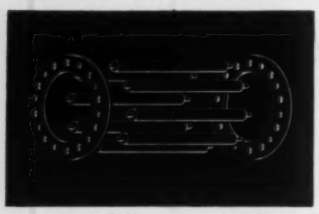
**The seven basic types in current use . . . their influence on bearing cost and performance . . . why one type is best suited to your individual design requirements**

Most cylindrical roller bearings consist of an inner race, an outer race, a complement of rollers, and a cage or separator which locates and guides the rollers. There are significant differences in the design and construction of these roller retainers. (The word "*retainer*" is used to designate both a cage, which retains the rollers, and a *separator* which only spaces the rollers.) Some retainers are simple and economical, well adapted for volume production, and designed for use where price is a primary consideration. Others are more costly to make but are designed for improved roller guidance, to insure cooler or smoother operation, or to provide longer life in heavy duty service.

Beginning with the most elementary, here are the seven basic types of cylindrical roller bearing retainers in current use, with a brief outline of their construction and characteristics:

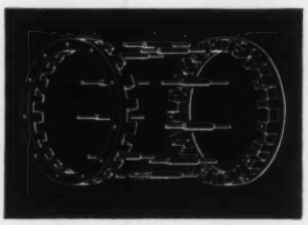
## 1. TRUNNIONED ROLLER CAGE

The trunnioned roller cage is used for bearings of very thin annulus, where the rollers must be small in diameter, closely spaced, and relatively long. The end rings are economical hardened steel stampings, into which the trunnioned rollers are inserted. The bars which connect the end rings are riveted to the rings at assembly so that the rollers and cage form an integral, non-separable unit. Thus, outer or inner races can be omitted if desired, with rollers operating directly on a suitably hardened shaft or housing bore. This cage is an economical design for volume production and possesses excellent operating characteristics for a wide range of applications.



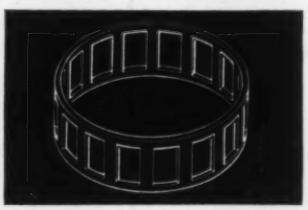
## 2. POCKETED END RING CAGE

The pocketed end ring cage is restricted to fairly large bore bearings with relatively long rollers. The end rings are bronze. The steel connecting bars are riveted into the end rings and the rollers operate in drilled pockets which guide them accurately. The construction has less tendency to twist or rack, and operates with less end friction because the outside faces of the bronze end rings are smooth uninterrupted surfaces. This type is known as a roller-riding cage, and makes no contact with the bearing races. It can be produced economically in small lots and since it is non-separable, bearing races can be omitted if desired. The characteristics of the pocketed end ring cage make it particularly desirable for applications where long life and heavy-duty service are required.



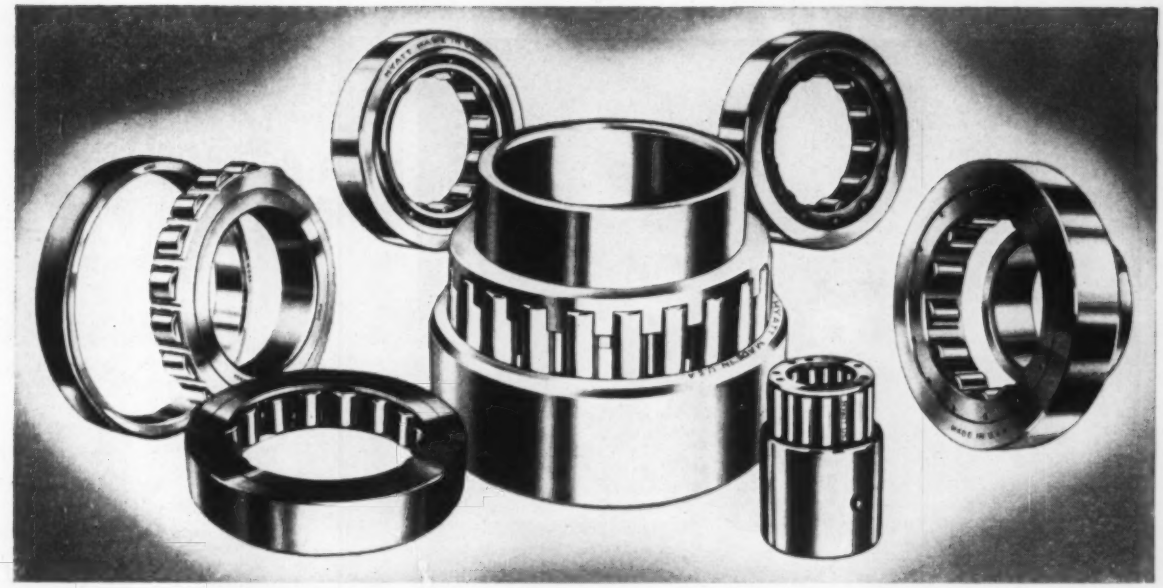
## 3. STAMPED STEEL SEPARATOR

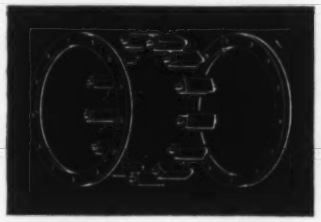
The stamped steel separator does not retain the rollers by itself, but merely separates them. It is a one-piece steel stamping with the separating bars coined to conform to the roller contour, and rides the rollers below their pitch line. Rollers are guided by the race flanges and snap rings, in conjunction with the cage bars. The simple, open design of this separator insures large grease capacity and good lubricant circulation, rendering it relatively insensitive to dirt. Since the separator is retained axially by the roller ends, there is no external requirement for axial location. The stamped steel separator is usable throughout a wide range of bearing sizes where rollers are relatively short (the Hyatt Hy-load series), and is economical for volume production.



## 4. FORMED BAR CAGE

The formed bar cage is built up of stamped end rings and bars formed to the roller contour. The end rings and bars are riveted together at assembly, making the race and roller assembly a non-separable unit. This cage is used on Hy-load bearings, with double-flanged inner or outer races. This

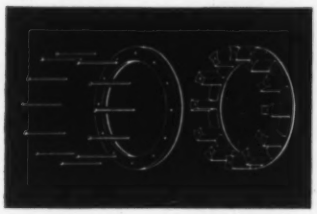




design insures quiet operation, better roller guidance, and provides a smooth contact surface between bars and rollers. This is a roller-riding design requiring no race contact in operation and is well adapted for volume production.

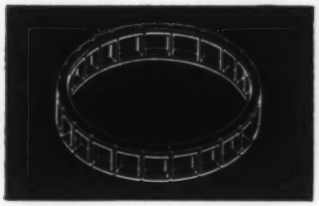
## 5. DRILLED POCKET CAGE

To construct this type, a bronze cylinder is drilled and reamed to form pockets in which the rollers operate. After the rollers are inserted, a flat end ring is riveted in place so that the rollers are permanently retained in the cage. This design provides extremely close control of the rollers in operation and prevents skewing which would impair both the thrust and radial capacity of the bearing. This is another roller-riding cage comprising a non-separable unit suitable for operation with inner or outer races omitted. The design insures superior performance and is used in applications requiring bearings of better than commercial quality.



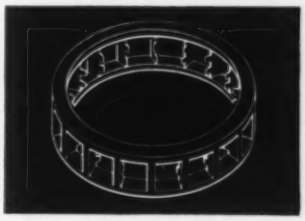
## 6. SEPARABLE BROACHED POCKET CAGE

This type is used only on the finest-quality bearings where performance is more important than price. It is made of one integral bronze cylinder, with pockets broached for maximum uniformity. This is the preferred type for the finest high-speed precision bearings because it insures minimum friction between rollers and separator, and allows better oil circulation for cooling at high speeds. Moreover, there are no thermal differences in this monolithic construction; the entire unit heats and cools uniformly. The separable feature offers the further advantage of roller removal for inspection of the race operating surfaces.



## 7. NON-SEPARABLE BROACHED POCKET CAGE

Similar in construction to the above, this design offers all the same inherent operating advantages. It is used in bearings where installation must be "blind," requiring rollers to be retained with the inner or outer race. Controlled roller drop is provided by deforming the connecting bars at assembly after the rollers are in place in the cage. This insures proper retainment but has the disadvantage that the bearing cannot be taken apart for inspection.

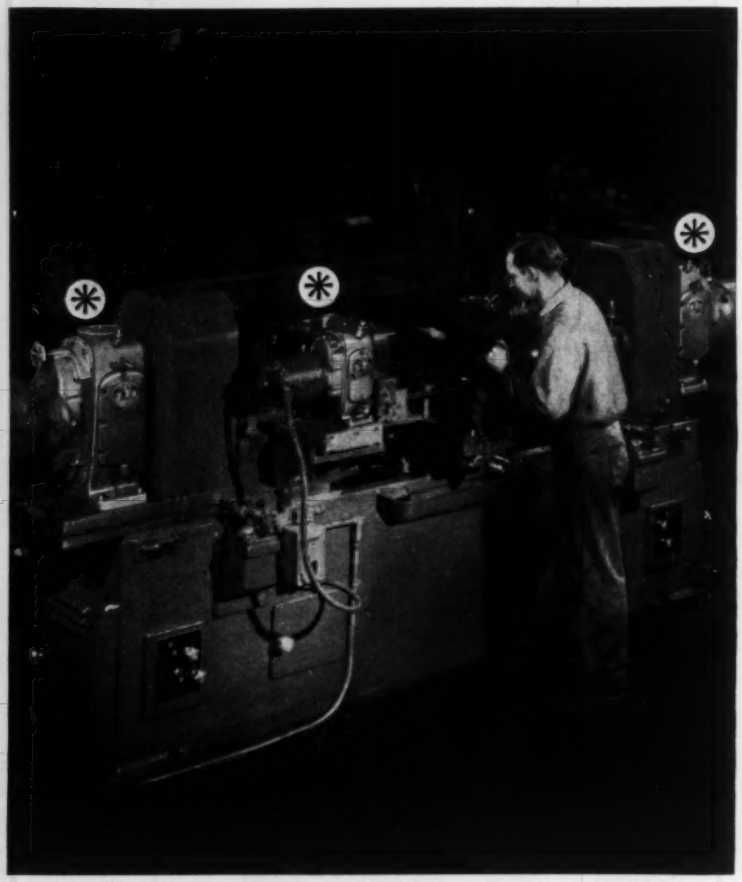


**HYATT MANUFACTURES ALL SEVEN TYPES** of cylindrical roller bearing retainers described above—each the finest of its type. You will find more details in HYATT General Catalog No. 150, or your nearby HYATT Sales engineer will be glad to help you choose the type best suited to your individual design requirements. Remember, HYATT is America's *first* and *foremost* maker of cylindrical roller bearings. Hyatt Bearings Division, General Motors Corporation, Harrison, New Jersey.

GM GENERAL MOTORS

**HYATT**

**ROLLER BEARINGS**



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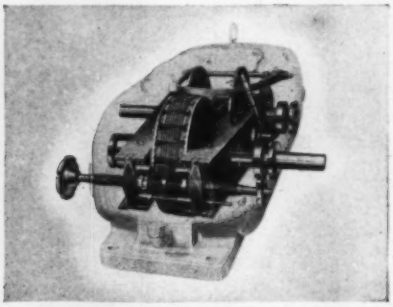
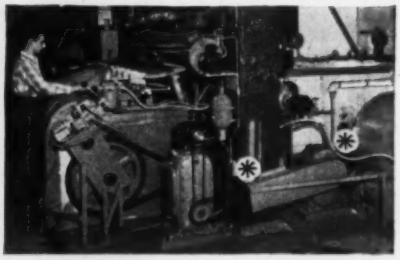


**ALL-METAL CONSTRUCTION,** shown in phantom, means long operating life with little wear and maintenance.



**AUTOMATIC CONTROLS** are available for self-regulation of P.I.V. This jute slasher is controlled electronically.

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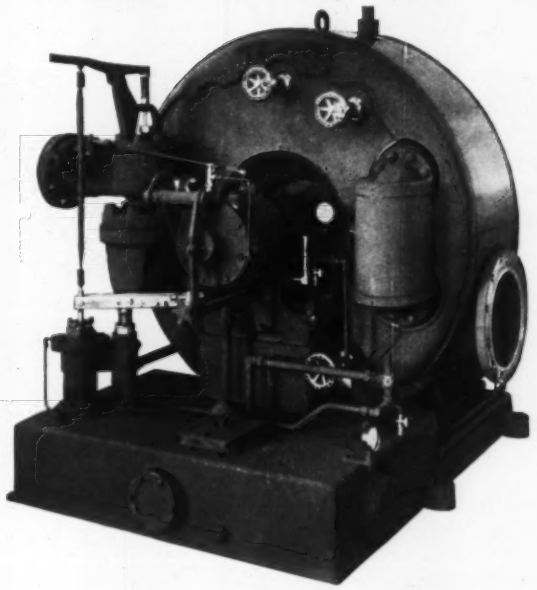

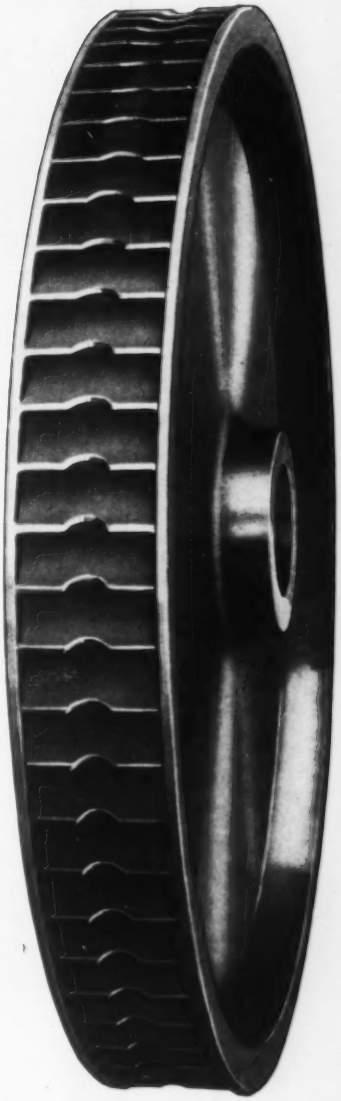

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Simplicity outside too—as you can see from the photograph of the 1500 HP at 3500 RPM solid wheel turbine above. This turbine is equipped with an oil relay governor and forced feed lubrication to the bearings.

For more about these *work horses of industry*, send for a copy of bulletin S-116. No cost or obligation.

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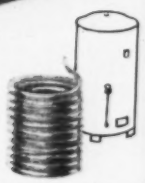
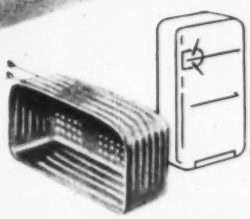
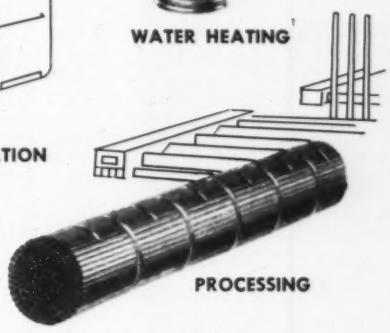


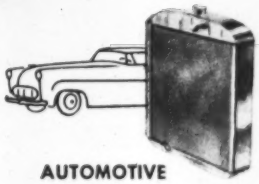
WATER HEATING



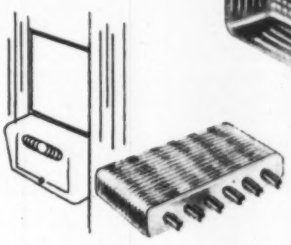
REFRIGERATION



PROCESSING



AUTOMOTIVE



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Here, for the first time, is a combination of tube and strip that is made from a single piece of metal! No joints! The product of intensive development by Revere's Research and Development Department, which sought and found a brand new way to give American industry tube plus strip that is more economical to buy, more economical to work, stronger and more efficient in performing 1,001 tasks.

*Remember Revere Tube-In-Strip is solid, not two strips welded, brazed, or bonded together.*

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METALS: Copper, Brass, other Copper Alloys, Aluminum, many others.

ECONOMY: You save in first cost, and in fabrication. New and improved designs are made possible. The web between the tubes conducts heat faster. The vastly increased structural strength means you can use lighter gauges, saving in weight and in price.

The applications of this radically new, different and superior Revere Product are unlimited. We most proudly present Revere Tube-In-Strip to the designers and manufacturers of American Industry. The Revere Technical Advisory Service and the Research and Development Department will gladly collaborate with you in taking full advantage of this marvelous new material.

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- Evaporators
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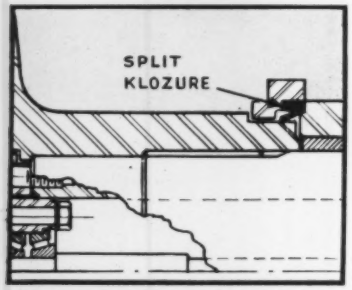


Cross section shows Garlock Split KLOZURE Seal as applied to the rotor assembly (main) bearing of Goodman's Type 401 Miner.

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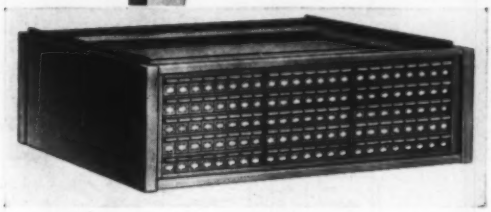

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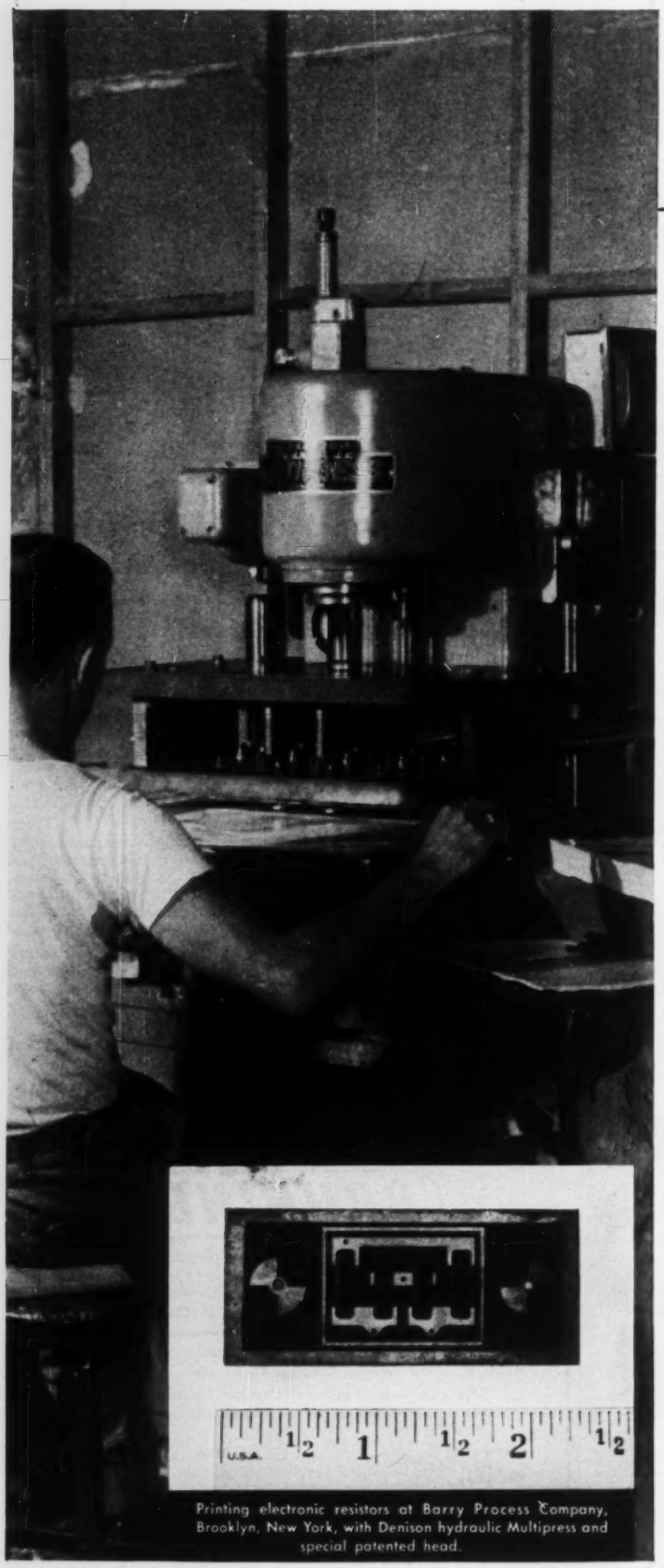


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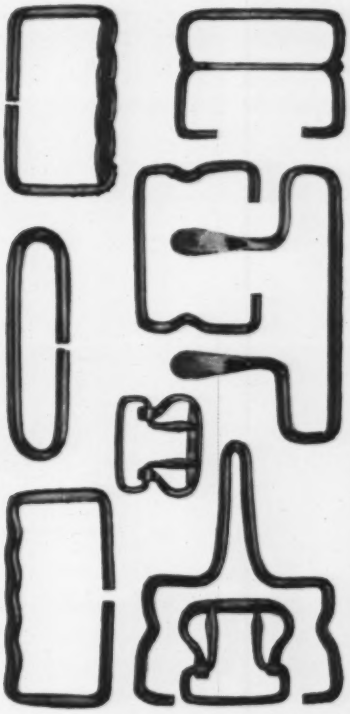
# Anaconda Wire now available in New Pay-off Container



**BUCKLES AND BUCKLE PARTS** made by West Haven Buckle Co., West Haven, Conn., using Anaconda 70-30 yellow brass wire. Finished buckles, later nickel plated, are of highest quality, noncorroding, for use in surgical bandages, trusses, corsets and other surgical appliances.

## Shutdowns to change coils in wire forming machines cut 90% at West Haven Buckle Company

The West Haven Buckle Company of West Haven, Conn., used to be limited to relatively light coils of brass wire because of the slide feed necessary for free pay-off into its wire forming machines. Machines could operate less than an hour before shutdown to feed in another coil.

When they started using Anaconda Wire packaged in the *new pay-off barrel*, which provides free pay-off, the runs were increased 10 times. The big coils of brass wire—400 to 500 pounds—made possible continuous runs of from 8 to 9 hours. This cut the time lost in changing coils 90 per cent. It eliminated the labor of shifting and lifting heavy coils—as the wire is fed directly from the barrel.

**An easy way to increase production, cut costs:** Big coils of Anaconda Wire in the *new pay-off barrel* give you these advantages:

1. Reduced down-time to change coils can mean production increases up to 25 per cent. Free pay-off feature may enable you to increase machine speed for still greater production.
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3. Easier handling, better inventory control. Barrels are clearly marked for quick identification—are easily handled by standard hand trucks—utilize storage space efficiently—can be stacked. Losses are minimized because coils stay clean indefinitely—there is no danger of coils becoming tangled or mixed.

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**THE NEW CONTAINER** which provides Anaconda Wire in 400 to 500 pound coils, ready for free pay-off into pin machines and other automatic forming machinery. Anaconda wire in all alloys is available packaged this way for long, continuous runs—in all gages up to .090", in tempers at least one number hard.

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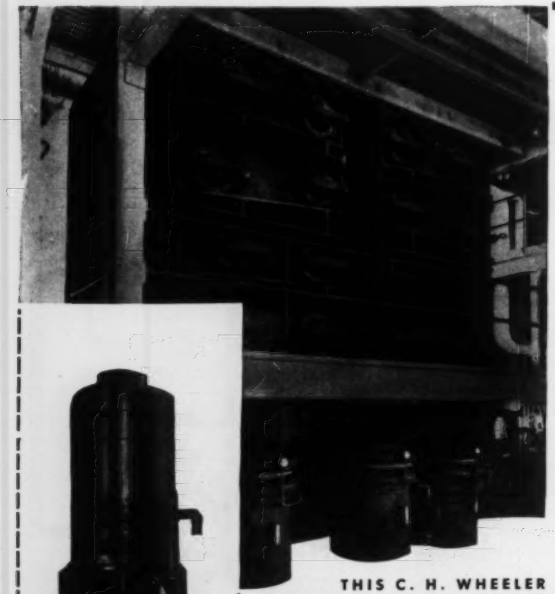
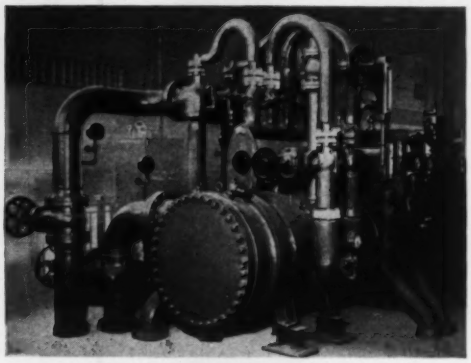


THIS C. H. WHEELER PATENTED REVERSE FLOW SURFACE CONDENSER is a two pass, divided water box, dual bank design capable of condensing 440,000 lbs. per hour of exhaust steam. Condensing surface is 55,000 square feet.



C. H. WHEELER TUBEJET AIR PUMP consists of two 2-stage elements, mounted on surface type inter-after-condenser. Each 2-stage element is designed to handle 97.5 lbs. per hour air vapor mixture at 1 inch HG absolute.

C. H. WHEELER CIRCULATING PUMPS are 30" x 42" Vertical Mixed Flow, pull-out type. Capacity is 30,000 GPM each at a total head of 36.2 feet. Pumps are driven by 400 HP, 600 RPM synchronous speed vertical induction type motors.

## New Deaerating Features Reduce Oxygen Content to Less Than 0.01 cc Per Liter

Progressive power companies are eliminating condenser shut downs and operation at reduced loads by installing C. H. Wheeler Patented Reverse Flow Steam Condensers.

One rapidly expanding utility has just put their fourth C. H. Wheeler Reverse Flow Condenser on the line. The latest unit, shown above, is not only "Self-Cleaning" but also has special new deaerating features that reduce the oxygen content of the condensate to less than 0.01 cc per liter. Continuous measurement by accurate recording instruments has proved that this low oxygen content is consistent over a wide range of load and temperature conditions.

Condenser circulating water used by this power company comes from a brackish river, laden with debris and leaves which clog steam condensers of regular design. "Self-Cleaning" C. H. Wheeler Patented Reverse Flow Condensers have solved their problem of how to avoid the expensive shut downs required to hand clean clogged tubes and tube sheets.

Debris is flushed away from the tubes and tube sheets simply by reversing the flow of cooling water through the condenser by means of hydraulically controlled built-in valves. Cleaning takes only a matter of minutes and can be accomplished under full load operating conditions with only a slight vacuum reduction. The power plant therefore can operate at full capacity round-the-clock.

Whatever your problems are . . . down time, deaeration, special operating conditions or requirements . . . let C. H. Wheeler help you solve them. Our engineering skill and experience can pay you high dividends in economy and efficiency.

Phone or write your local representative or our Philadelphia office for literature, information, or assistance.

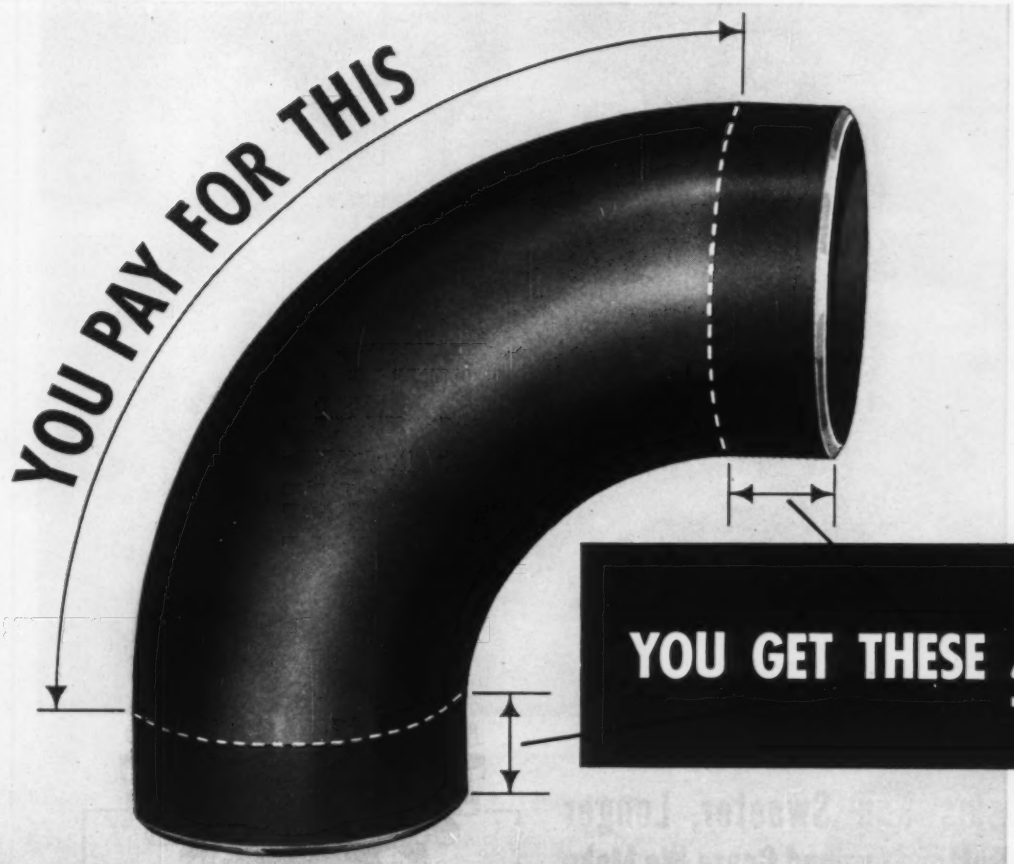
WE507

C. H. Wheeler OF PHILADELPHIA

C. H. WHEELER MANUFACTURING CO., 19TH & LEHIGH, PHILA. 32, PENNA.

STEAM CONDENSERS · CENTRIFUGAL, AXIAL AND MIXED FLOW PUMPS · STEAM JET EJECTORS · VACUUM REFRIGERATION · HIGH VACUUM PROCESS EQUIPMENT
MARINE CONDENSERS AND EJECTORS · MARINE PUMPS · DECK MACHINERY

# MIDWEST "LONG TANGENT" ELBOWS




**In no other welding elbow do you get this "bonus" of long tangents. The dotted lines show where standard elbows end. Each shaded straight end equals ¼ of the nominal fitting diameter . . . a 12" Midwest "Long Tangent" Elbow has tangents 3" long. As a result of the advantages listed at the right, substantial savings are made on many piping systems by using Midwest "Long Tangent" Elbows . . . which cost no more than other elbows. For further information, write for Catalog 54.**

**MIDWEST PIPING COMPANY, INC.**
Main Office: 1450 South Second Street, St. Louis 4, Mo.
*Plants: St. Louis, Passaic and Los Angeles*

*Sales Offices:*
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Cleveland 14—616 St. Clair Ave. • Miami 34—2103 Le Jeune Rd.
*STOCKING DISTRIBUTORS IN PRINCIPAL CITIES*

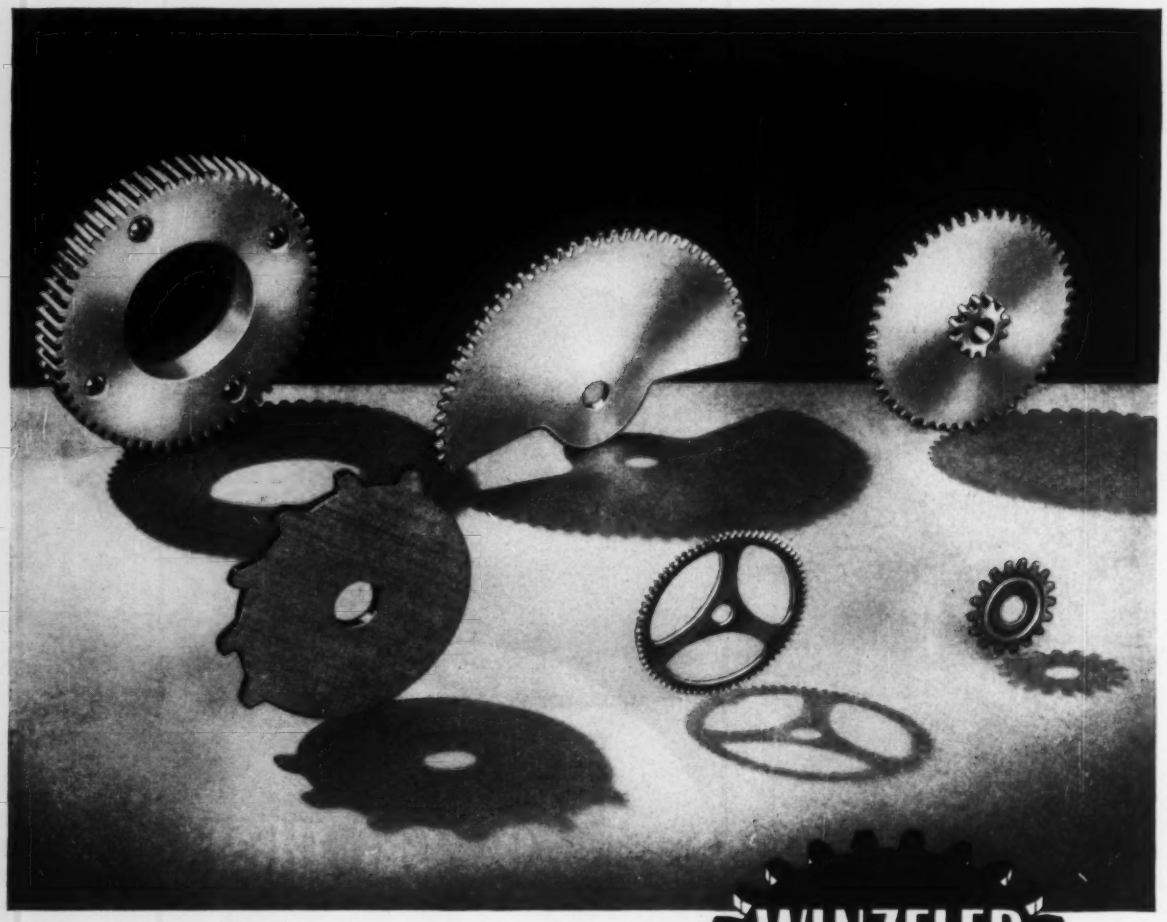
## ADVANTAGES OF MIDWEST "LONG TANGENT" ELBOWS

- ★ They save pipe.
- ★ They often eliminate short nipples and their extra welds.
- ★ They save time and money in lining up and clamping pipe and fitting.
- ★ They make it easier to apply slip-on flanges.
- ★ They remove the circumferential weld from point of maximum stress and can be sleeved.
- ★ THEY COST NO MORE THAN OTHER ELBOWS

**MIDWEST HAS THE MOST COMPLETE LINE**

7325

MIDWEST WELDING FITTINGS IMPROVE PIPING DESIGN AND REDUCE COSTS



# Mechanisms Run Sweeter, Longer with the Better Stamped Gears We Make

A Gear *stamped* by WINZELER measures up to a remarkable degree of accuracy. Whether we make them by hundreds or thousands . . whether it's a little spur or a big, laminated, wide face Gear . . EACH ONE will equal or surpass the most exacting specifications!

Think what that means in smoother, sweeter performance. And think even more of the big saving in cost and assembly time. Then, too, greater satisfaction with your product brings a larger and more profitable business. These are some of the reasons why the use of WINZELER *Stamped* Gears has grown so fast. More and more critical manufacturers from coast-to-coast come to us for *all* of their needs. You, too, should sample the many superior advantages these better Gears give. We stamp them in production runs from any material. Sizes range from 8 to 96 dp and from .006 to ¾" thickness. Will you tell us exactly what we can do to help you?

WINZELER
*Stamped Gears*

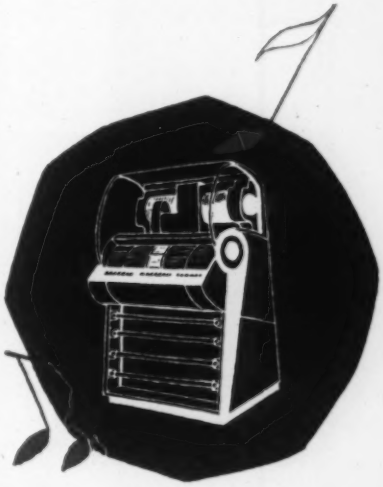
## FREE! STAMPED GEAR GUIDE

***WRITE TODAY*** *for useful 4-page folder . . . a valuable guide to all that is best in the mass production and use of low-cost Stamped Gears, Tools and Assemblies. Many various types are described. Also contains technical data, tables, ideas, suggestions. Use company stationery, please!*

**WINZELER MANUFACTURING & TOOL CO.**
1712 WEST ARCADE PLACE • CHICAGO 12, ILLINOIS

# sound from silence . . . .

The J. P. Seeburg Corp. has worked hand in hand with The United States Graphite Company in developing self lubricating bearings and parts which meet the exacting requirements of the most successful high fidelity coin operated phonograph made today.



## GRAMIX®

**products from powder metallurgy**

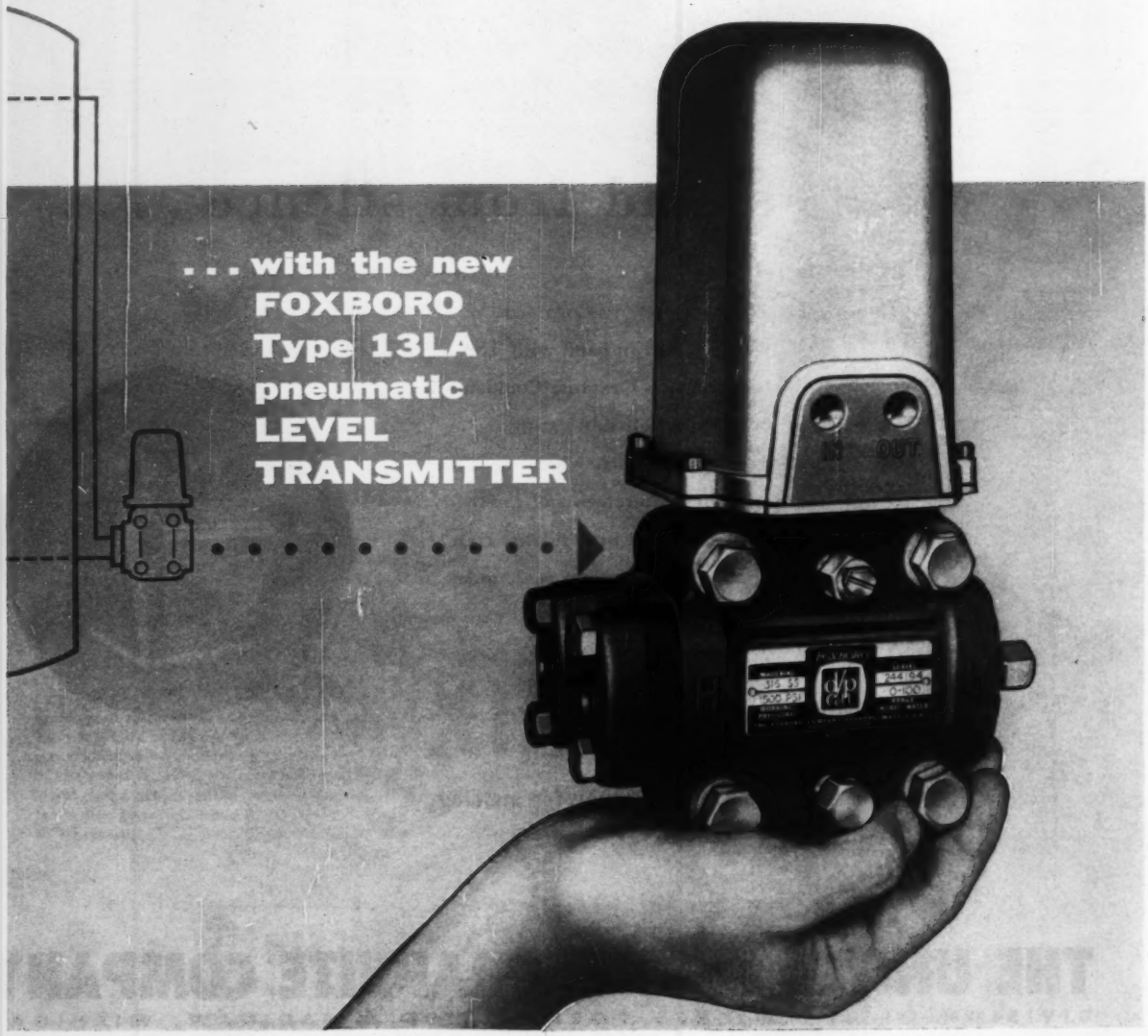
112

## THE UNITED STATES GRAPHITE COMPANY

**DIVISION OF THE WICKES CORPORATION • SAGINAW, MICHIGAN**

NEW SIMPLICITY

# FOR LIQUID LEVEL



# MEASUREMENT !

**Easy Low-Cost Installation** on any closed or open tank. Only two small pressure taps required. Nothing inside tank!

**Fully-Adjustable Ranges** . . . 0-20" to 0-80" and 0-50" to 0-250" $H_2O$.

**Complete adjustment** for elimination of outside leg effect gives forward-reading signal to any standard receiver!

**Highest Sustained Accuracy** . . . Instant, precise response to level changes even under extreme operating conditions.

**Rugged and Corrosion-Resistant** . . . Level-sensing element is Type 316 stainless steel, silicone-filled "capsule" diaphragm applicable on static pressures up to 1500 lbs.

There's nothing simpler for accurately measuring liquid level than the Foxboro Type 13LA d/p Cell* Liquid Level Transmitter! No floats, knife edges, stuffing boxes, or complicated hook-ups. A simple, direct piping job connects it to the tank . . . operates in any position, even upside down. The Transmitter precisely measures difference in head caused by level change . . . sends 3-15 psi air signal over single air line to indicator, recorder, or controller. It's easily traced when required, up to 250°F., to maintain fluidity of liquid.

The 13LA d/p Cell Transmitter is low in initial cost, requires practically no maintenance. In addition, it is easily converted in field for the measurement of fluid flow. It's the ideal instrument for heavy industrial applications . . . indoors or out. For complete details, ask your nearest Foxboro Sales Engineer, or write for new Bulletin 13-22 to The Foxboro Company, 962 Neponset Ave., Foxboro, Mass., U.S.A.

*Reg. U. S. Pat. Off.

FACTORIES IN THE UNITED STATES, CANADA, AND ENGLAND

FOXBORO
REG. U. S. PAT. OFF.

LIQUID LEVEL TRANSMITTER

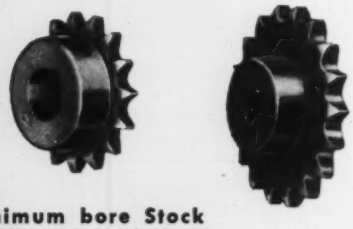
ALWAYS PRELOADED

Labeled and packaged 10′ lengths—reels of 50′ or more.

# ROLLER CHAIN AND SPROCKETS

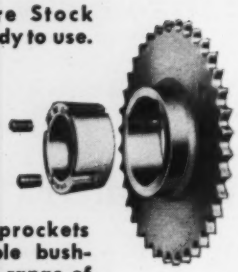
The Stock assortment of minimum bore Stock Sprockets for reboring, finished bore Stock Sprockets, and Taper lock bushed Stock Sprockets with wide range of Stock Bores give you all you need to meet most power transfer conditions.

Save time, save costs of reworking sprockets—with *stock* Diamond Roller Chains and Sprockets . . . See your Distributor. Write for Catalog 754.



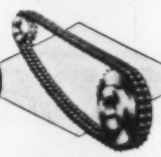
Minimum bore Stock Sprockets for reboring.

Finished bore Stock Sprockets—ready to use.

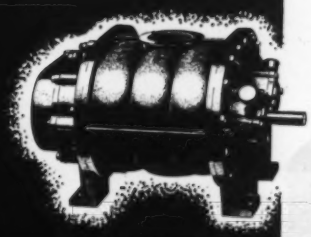


Taper lock Sprockets with replaceable bushings to fit wide range of bores.

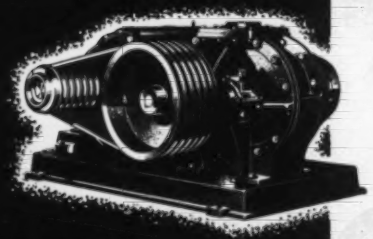
**DIAMOND CHAIN COMPANY, Inc.**
*Where High Quality is Traditional*
Dept. 413, 402 Kentucky Avenue, Indianapolis 7, Ind.

DIAMOND  ROLLER CHAINS

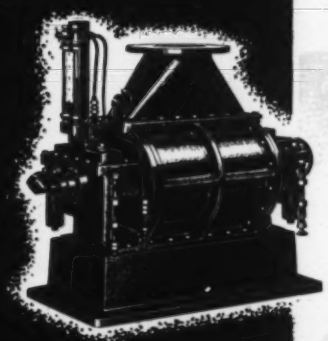
*Offices and Distributors in All Principal Cities*
Please refer to the classified section of your local telephone directory under the heading CHAINS or CHAINS-ROLLER



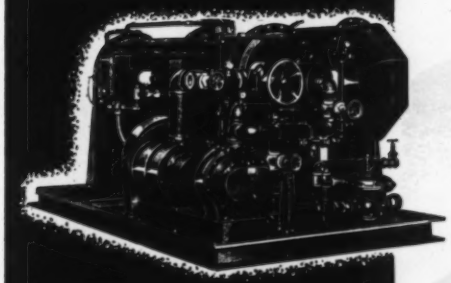
BLOWERS for such widely varying needs as lifting a damaged airplane or injecting air into water to provide oxygen for safe transportation of fish in tanks. Capacities as low as 5 cfm or up to 100,000 cfm or higher.



GAS PUMPS for inflating balloons, manufacturing electronic tubes or extracting gases from contaminated areas for test samples. They'll deliver as little as 5 cfm or as much as 50,000 cfm or more.



METERS help save money or make more profits by accurately measuring almost any kind of gas which you buy, sell or use in manufacturing processes. "Cash register accuracy" from 2,000 to a million cfh.



INERT GAS GENERATORS make hazardous operations safer from fire or explosion. They protect people, plants and products . . . and often return more than they cost in reduced insurance premiums. They'll produce inert gas for almost any use. You can have as much as 50,000 cfh or as little as 1,000 cfh in mobile or stationary equipment.

# How to pull DOLLARS out of the AIR

New ways to put air (or gas) to useful, profitable work are constantly being developed by engineers and designers. These result in more effective machines and devices—frequently replacing slower or more expensive methods—often reducing the first cost of the equipment itself. These results are accomplished . . .

## by resourceful engineering

In many of these applications, designers and engineers have utilized standard R-C equipment, sometimes with special adaptations. The problem may call for a small or large volume of air, moved by R-C Blowers or Exhausters. It may require vacuums, produced by R-C Vacuum Pumps. Perhaps metering or pumping of gas is needed, also met by R-C products. In any event, the solution is often . . .

## aided by Roots-Connersville experience

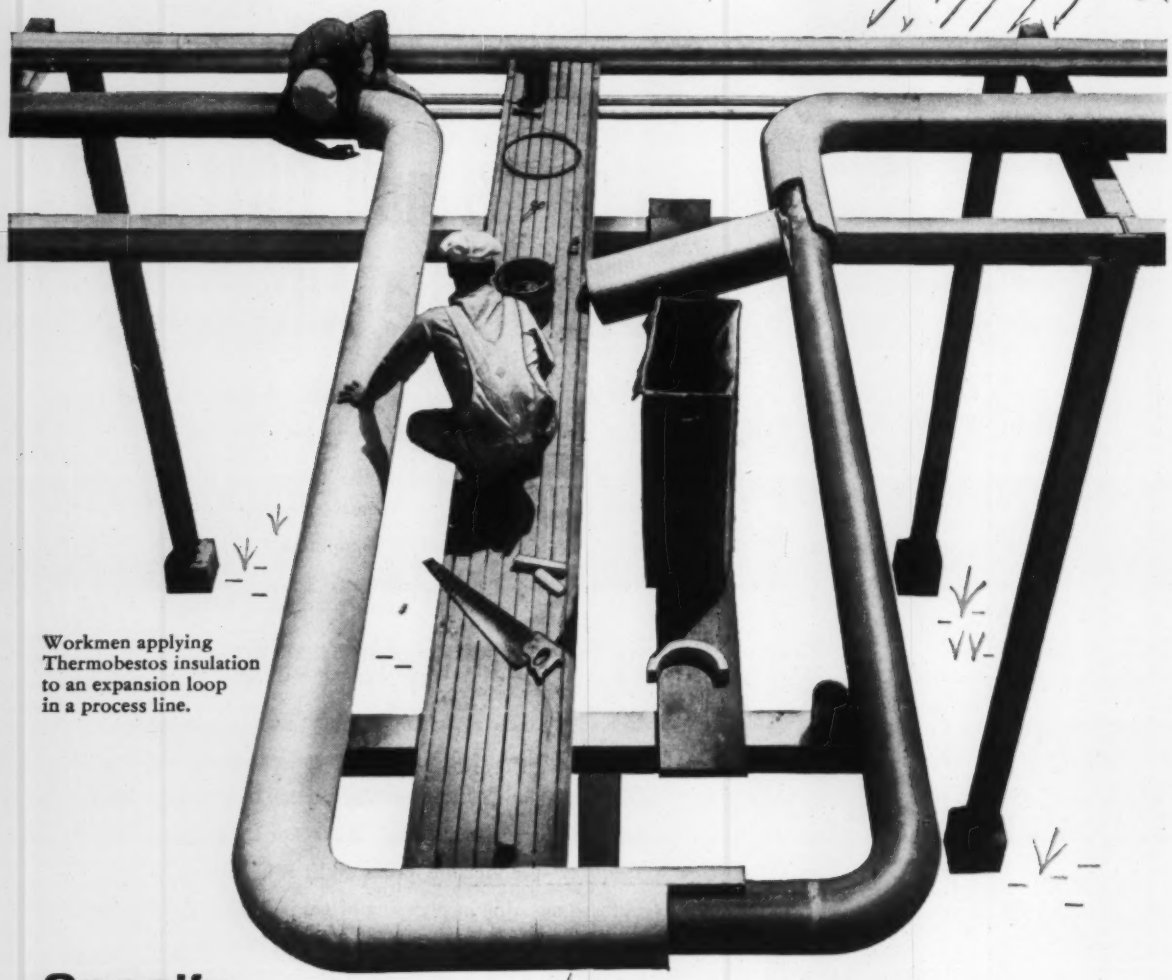
If you use or build for resale any product which might be improved by utilization of air at moderate pressures, by vacuums or by moving gas, perhaps we can help you. Even if you have only the ghost of an idea that might pull dollars out of the air, we'll gladly work with you.

**Just address:**
***Product Development Manager, Roots-Connersville Blower Division, 256 Michigan Ave., Connersville, Indiana.***

**ROOTS-CONNERSVILLE BLOWER**

**ONE OF THE DRESSER INDUSTRIES**

*When you're fighting the weather as well as heat loss*



Workmen applying Thermobestos insulation to an expansion loop in a process line.

**Specify**

## J-M THERMOBESTOS® the heat insulation designed for outdoor process industries

**Here's proof** that rugged physical strength and high insulating efficiency can be combined in one material. J-M Thermobestos is strong and rigid, yet light enough for easy handling and fast application. It is not damaged by prolonged wetting. Its hard composition resists crushing and will withstand unusual service abuse. The low conductivity compares favorably with other accepted industrial insulations. This unique combination of properties means excellent temperature control and minimum maintenance cost for oil refineries, chemical processing plants and other plants with outdoor vessels and hot piping.

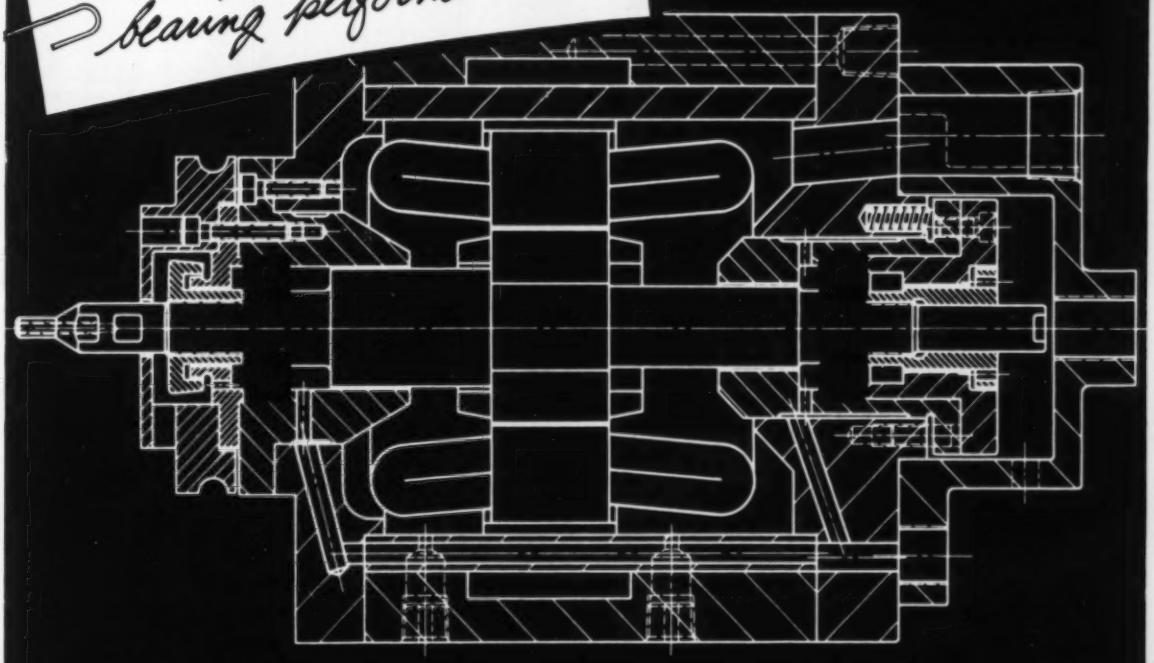
**Made from calcium hydrosilicate,** Thermobestos is molded to size for proper fit. Its high strength makes it particularly adaptable for time-saving shop prefabrication of fittings and bends. Furnished in large sections, Thermobestos is easy to apply. It reduces the number of joints. In pipe insulation form, it comes in a complete selection of sizes up to 24″ x 3″ half-sections. Also available in 6″ x 36″ and 12″ x 36″ blocks in a full range of thicknesses. For further information write to Johns-Manville, Box 60, New York 16, N.Y. In Canada, Port Credit, Ontario.

JM PRODUCTS

**Johns-Manville *first-in* INSULATION**

**MATERIALS · ENGINEERING · APPLICATION**

*Looking for improved bearing performance?*



# over 14 billion revolutions...

– and still going strong

Fafnir Super-Precision MM201W1-CR spring-loaded ball bearing, the type specified for wheelhead illustrated.

**Fafnir-equipped, high-speed, oscillating grinder wheelhead demonstrates machine tool progress in performance**

This extraordinary record has been made on the production line by a Pope-built wheelhead, grinding the races of extra-precision ball bearings. The hi-frequency motorized wheelhead operates at 72,000 rpm. The motor is water-cooled and bearings lubricated by means of an oil-air mist system.

When designing this oscillating grinder wheelhead, Fafnir engineers worked together with the Pope Machinery Company engineers in the selection and application of bearings. The type of bearing recommended is shown at the left and its application in the drawing above. Its performance record, according to Pope, demonstrates progress to match today's improved machine tools.

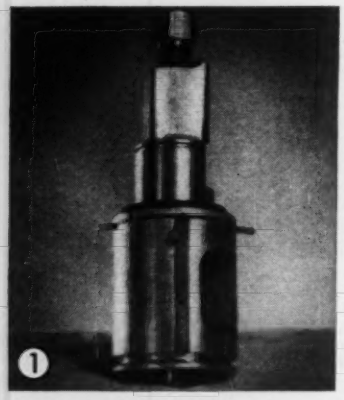
Whatever your bearing problem, a few minutes spent with a Fafnir representative may be the means of solving it as successfully. Write The Fafnir Bearing Company, New Britain, Connecticut.

**FAFNIR**
**BALL BEARINGS**

*MOST COMPLETE LINE IN AMERICA*

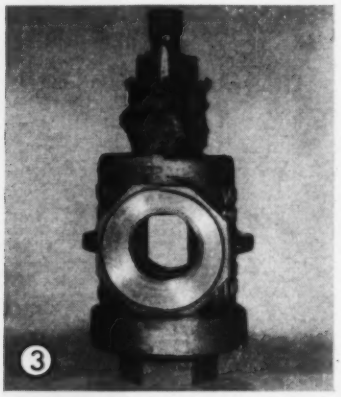
# *SEE HOW *Controlled*
## PRESSURIZED LUBRICATION
GUARANTEES LOWEST COST SERVICE FROM

# HOMESTEAD *lubricated* PLUG VALVES

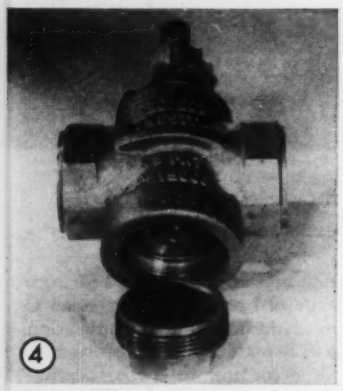



This plug was removed from a Homestead Valve just after starting lubrication, and before all sealing areas were filled with lubricant. Note that pressurized lubricant continues to extrude through feeder holes. Momentary downward movement of plug at start of each lubrication, gives assurance that plug is always free to turn.

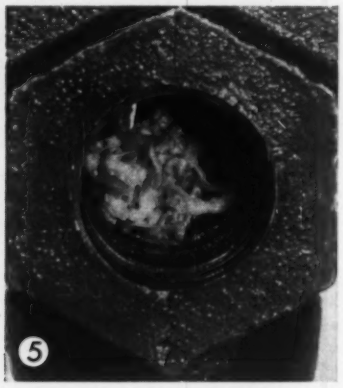
The plug was again withdrawn from the valve body just after a ring of lubricant around the stem indicated that the lubricant system was full. Note that all lubricant grooves are filled. The entire plug surface is coated with lubricant. Lubricant is well packed in the stem sealing area above the plug.




Now valve has been purposely over-lubricated as indicated by excess lubricant around stem. Note that with *controlled* pressurized lubrication there is no extrusion or seepage of lubricant into valve port opening. This means no waste, no contamination of line fluids, no clogging of low pressure lines with lubricant, or fouling of meters, orifices, etc.




Also, in the Homestead Valve with *controlled* lubrication, you will note that even though the valve has been over-lubricated, lubricant comes only to the bottom edge of the plug, and is not wasted by discharging in quantity into the bottom chamber.




Now, see for yourself the risk involved when a valve which does *not* have Homestead's *controlled* Pressurized Lubrication, is over-lubricated. Note lubricant has been forced into the port opening. It can contaminate line fluids, foul meters or orifices, or even block low pressure lines!

* Unretouched photos.

These are but a few of the many advantages of Homestead's controlled pressurized lubrication that guarantee lowest cost valve service.

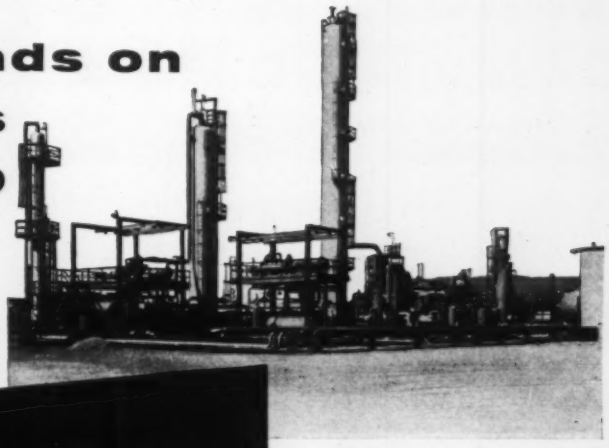
Reference Book 39-5 has the full story—twenty-eight pages of engineering facts, sizes, types, dimensions, etc. Ask for your copy today. There is no obligation.

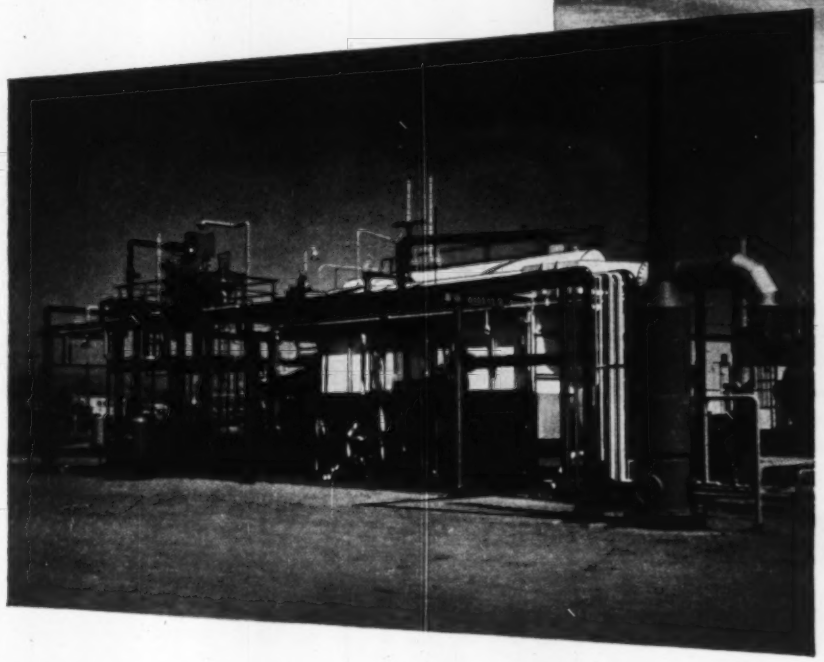
HOMESTEAD LUBRICATED PLUG VALVE (Pat. Pend.)

**HOMESTEAD VALVE MANUFACTURING COMPANY**

P. O. Box 38 *"Serving Since 1892"* Coraopolis, Pa.

# Everything depends on the boiler flue gas at this $1,500,000 Liquid plant





## ERIE CITY VL selected because of it's high . . . $CO_2$ flue gas

*Liquid Carbonic Corporation, world's largest producer of $CO_2$ in liquid, gas and dry ice forms, operates the world's largest automatic processing plant of its kind at Oakland, California.*

Boilers used in the manufacture of dry ice and liquid $CO_2$ are specially designed and are an integral part of the process. When Liquid Carbonic specified the quantity of $CO_2$ to be produced at its Oakland, California plant, Erie City engineers met their stringent requirements.

They designed and built the boiler, holding excess air to a minimum, while insuring complete combustion to obtain a high $CO_2$.

The entire operation at this plant is dependent upon the quantity of $CO_2$ that leaves the boiler. Unlike other boilers, steam production in this VL is incidental but is fully utilized to power the process.

Liquid Carbonic Corporation has for years found Erie City boilers dependable in this unique, severe application. The Oakland, California installation is one of many with Erie City boilers.

If you would like the complete story on the Erie City VL write for SB-434.

ERIE CITY
116 Years in Steam Generation

*You can depend on Erie City for sound engineering*

**ERIE CITY IRON WORKS • *Erie, Pa.***

STEAM GENERATORS • SUPERHEATERS • ECONOMIZERS • AIR PREHEATERS
UNDERFEED AND SPREADER STOKERS • PULVERIZERS

Capital Airlines recently added the first of 60 Vickers Viscounts to their fleet . . . powered by the Rolls-Royce "Dart" engine, a new "turbo-prop" design. These engines assure an almost noiseless, vibrationless flight.

# New engines that murmur instead of roar

All you hear in flight is a subdued "whoosh" . . . the pleasant, hushed voice of Capital's fabulous new "turbo-props."

**And reduced, along with the old-fashioned engine roar, is vibration.** Everything's so calm, you can even balance a quarter on edge . . . at 335 m.p.h.

That's the kind of ride to expect when you travel on speedy new Capital Viscount planes. Their Rolls-Royce "turbo-prop" engines make possible this extra quiet, extra fast, extra smooth travel experience.

**How does this new "turbo-prop" engine work?** Something like a military turbojet. Except that the "turbo-prop" uses most of the hot gases' energy to spin a propeller. In a jet, the gases stream out the tail to create thrust.

In designing this engine, one big problem had to be licked . . . the intense, internal heat. Gases burn at well over 1600°F. in the combustion chambers. That's hot enough to burn away some metals . . . and sap the strength of most. What metal could take it? For the combustion chamber liners? For the spinning turbine blades . . . that become white-hot under the unremitting blast of hot gases?

**Happily, International Nickel had the ready answer** to both problems. Nimonic "75"*. . . because of its great resistance to oxidation and high temperature corrosion . . . is giving excellent service lining combustion chambers. Turbine blades are of tremendously strong and heat-resisting Nimonic "80A"*.

Credit for much of the engine's high performance and reliability comes from its use of nickel alloys in flame tubes, turbine blades, cones and nozzles. Nickel-bearing steel alloys keep other vital parts on the job. In fact, six percent of the engine's total weight is nickel.

**Are you searching for a metal** that will stand up at high temperatures? Resist corrosion? Withstand wear? Provide some unusual electrical property? Then write for our handy guide to more than 20 alloys developed specifically to give longer, better service under these conditions. Write us at 67 Wall Street, New York 5. *Trademark

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**INTERNATIONAL NICKEL**

*Nickel Alloys Perform Better, Longer*

Volume 78 • Number 2

February 1956

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# MECHANICAL ENGINEERING

Developments in Instrumentation by the Petrochemical Industry . . . . *R. G. Marvin, W. L. Stuart, G. W. Lunsford, and E. E. Ludwig* 132

How to Improve Profits—A Challenge to Engineering . . . . . *K. L. Block* 135

Process Control by End-Point Analysis . . . . . *S. M. Rock and Jack Walker* 137

Field-Testing a Reversible Pump-Turbine . . . . . *F. E. Jaski* 141

Consumable-Insert Technique for Pipe Welding . . . . . *R. D. Thomas, Jr.* 145

Some Major Findings of the Hoover Commission . . . . . *S. C. Hollister* 150

A Role for Student Professional and Honorary Societies in Engineering Education . . . *R. C. Dean, Jr.* 154

*Editorial* . . . . . 131

*Briefing the Record* . . . . . 156

Continuous Casting, 156; Future Heavy-Press Considerations, 157; 2200-Lb Vacuum-Melting Furnace, 158; Storm Surges Project, 158; Liquid-Metal Fuel Reactor, 159; Radioactivity Well Logging, 160; Atomic Food Preservation, 161; Steam Power Plants, 161; Headerless Steam Generator, 162; Gasoline Injection System, 162; Airborne Digital Computer, 164; Ultrathin Glass Paper, 164; Improved Incandescent Lamp, 165; Radar Gravity Switching Yard, 165; Switching Yard Photos, 166

*European Survey* . . . . . 168

The "Deltic" Engine, 168; Balancing Turbine Rotors in Place, 169

*ASME Technical Digest* . . . . . 170

Steam-Power Generation, 170; Hydraulics, 174; Water Hammer, 174; Metal Processing, 174; Applied Mechanics, 175; Heat Transfer, 176; ASME Transactions for January, 1956, 179

*Comments on Papers* . . . . . 180

*Reviews of Books* . . . . . 182

*ASME Boiler and Pressure Vessel Code* . . . . . 185

*ASME News* . . . . . 188

ASME Papers at Nuclear Congress, 187; ASEE Nuclear-Energy Institute, 191; Geneva Atomic Energy Conference Proceedings, 192; ASME Manuals and Annuals, 192; People, 192; 1956 ASME Spring Meeting, 194; Indexes to ASME Papers, 195; Fourth ASME Engineering Management Conference, 195; ASME Coming Events, 195; Schedule of 1956 RAC Meetings, 196; ASME Aviation Conference, 196; ASME Receives Letter of Appreciation From State Department, 197; ASME Machine Design Division, 198; Meetings of Other Societies, 198; U of P to Prepare More Engineers, 198; Junior Forum, 202; ASME Membership, 203; ASME Standards Workshop, 203; ASME Executive Committee Actions, 204; Personnel Service, 205; Candidates, 208; Obituaries, 208

*Classified Advertisements* 143 *Consultants* . . . . 166
*Advertisers* 168

## New $7,000,000 radar gravity switching yard . . .

. . . dedicated by Southern Pacific Lines near Houston, Texas, is the first of its kind to be built in the Southwest and is equipped with radar-activated car-braking equipment. The new "hump yard" is four miles long and 1500 ft wide with a 27-ft crest and a maze of switches leading to the 48 classification tracks. For further details see pages 165 to 167 in this issue.

Volume 78 • Number 2
FEBRUARY 1956
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George A. Stetson, *Editor*

# MECHANICAL ENGINEERING

## Know Your ASME Publications

In the early days of The American Society of Mechanical Engineers conditions were favorable to simplicity and unity of operation. The Council had the responsibility of planning technical meetings and of reviewing and selecting papers to be printed in the Transactions. At the technical meetings—two each year—all members present gathered in a single room with the President in the chair. ASME publications consisted of *Proceedings* (news of the Society's affairs and preprints of technical papers) and Transactions, in which technical papers of "permanent" value, with discussion, were printed. Members received these dues-supported publications.

Today Mechanical Engineering has taken the place of *Proceedings* (with additional functions) and is sent to every member, but preprints of papers are issued as individual pamphlets which a member may purchase according to his needs. Transactions is on a subscription basis and no member pays unless he elects to subscribe. These, and more than 250 codes, standards, and special publications, are supported by income not derived from dues.

How vastly the activities of the Society have increased and diversified in three quarters of a century can be sensed by reading the ASME Council report for 1954–1955 which appeared on pages 53–61 of our January issue and the Reports of Committees to the Council, a booklet of 129 pages, which may be obtained from the Secretary.

In the year covered by the report of the Council, ASME membership numbered about 40 thousand, exclusive of student members. The Society held 18 national meetings and conferences at which 682 technical papers were presented. Of these technical papers 530 were available in preprint form. Abstracts and "availability lists" of these preprints appeared in Mechanical Engineering with order blanks for the convenience of members; and each member received ten "free" coupons which he could exchange for an equal number of preprints.

With increase in number of members and a constantly expanding diversity of specialized interest of members, the simplicity and unity which marked ASME activities in the early days no longer exist. Even if it were possible to find suitable accommodations in a single auditorium for all of the members who attend an ASME Annual Meeting the percentage of the audience that would be interested in any one technical paper would be small. To present such a program as was carried out at Chicago last November would require a full month of sessions filling the morning, afternoon, and evening of every day. The only practical scheme for handling such a program is to provide numerous simultaneous sessions, each sponsored by a specialist group like a Division or Committee, and to let the individual member decide for himself which sessions he will attend.

Since only papers of the highest quality and most permanent value are selected for Transactions (some papers are of sufficient general interest to appear in Mechanical Engineering) the number of technical papers printed in full with discussion is something less than half of the number presented at meetings. Volume 77 (1955) of Transactions, ASME, including the *Journal of Applied Mechanics*, contained 247 papers (2008 pages). Papers that are available in preprint form but not selected for printing in Transactions or Mechanical Engineering are bound by the Engineering Societies Library and are permanently available there for consultation. Photostats of these papers may be purchased at any time in the future.

The great diversity of specialized interests of members has made it impractical, without greatly increasing members' dues, to follow the early practice of the Society and provide all ASME publications to every member. Under present practice each member is expected to select and purchase the papers and publications he desires. So that he may know what is available to him, abstracts of papers and announcements of other Society publications appear in Mechanical Engineering.

To keep every member posted on the extent and availability of all ASME publications and to make it easy for members to locate preprints and papers, ASME Annual, AM5, Indexes to ASME Papers and Publications, is now available to members on request. This Annual is a reprint of Section 2 of the January issue of Transactions. It includes: (1) A list of libraries where files of Transactions are maintained; (2) a list of publications issued in 1955; (3) a list, with prices, of all ASME standards, codes, research reports, biographies, and books and pamphlets on special subjects currently available; (4) a list of ASME Miscellaneous Papers filed in the Engineering Societies Library; and (5) author and subject indexes for 1955 issues of Mechanical Engineering, Transactions, and *Journal of Applied Mechanics*. The Index Annual will give every member a useful means of locating papers that have appeared during the year.

# Developments in Instrumentation

## . . . . by the Petrochemical Industry

By R. G. Marvin,[1] W. L. Stuart, G. W. Lunsford, and E. E. Ludwig

Engineering Department, The Dow Chemical Company, Freeport, Texas

ELECTRICAL, electronic, and pneumatic instruments have found wide application in the petrochemical industry. The rapid growth of this industry has created a program of instrument design and development by many petrochemical companies with the full co-operation of the instrument manufacturers. This paper presents a few selected examples of instrument development which place emphasis on the interest of the petrochemical industry in applying the latest and best techniques for the instrumentation of commercial processes.

### Relative Flow Measurement at High Pressure

The measurement of the flow of gases at high pressure has been a rather difficult service for instruments of today. Some work has been done and is continuing to be done to improve the accuracy of absolute measurement of gas flow in the region of 3000 to 50,000 psi. Since the major instrument manufacturers and various other companies specializing in difficult applications could not —at the time—offer flowmeters or other equipment to handle this problem, in measurement at 3000 to 9000 psi, the petrochemical company undertook to solve it.

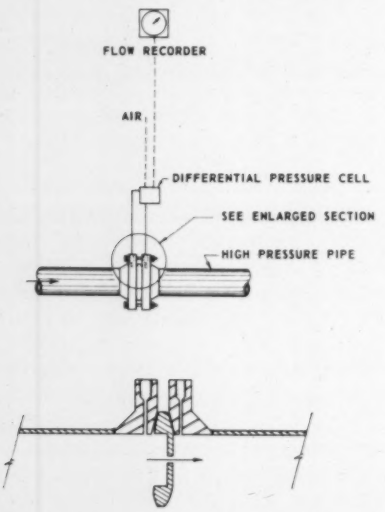



**Fig. 1 Schematic arrangement and section of orifice-flange installation for high-pressure-flow measurement**

Calculations indicated that drilling $^1/_8$ or $^1/_4$-in-diam holes radially through the existing flanges would not affect the safety of the flanges in the piping system. The taps in the flanges were not exactly in the positions required according to the best practice; however, they were placed in the only locations possible. By checking after installation, the accuracy was established to be plus or minus 7 per cent.

The orifice was installed in the line between the flanges with no change in the piping-system dimensions. Fig. 1 shows schematic arrangement and section of orifice-flange installation. In this installation one flow is compared with another flow which is parallel and which fluctuates in a somewhat similar manner. Controls can be established from any selected point and should then give relative readings. The pressure differential of the flange taps is picked up by a special high-pressure differential-pressure transmitter. The readings are then pneumatically recorded in the control room. Control-valve adjustment to keep the systems balanced is made by pneumatic remote hand-valve operation.

### Ratio Flow Control of Two Gas Streams in a Process

Some petrochemical processes use gas-phase reaction. To make the operation efficient and successful, close control of the raw material is necessary. Failure to meet this requirement could result in loss of production, and waste of power and other service in handling the process constituents.

Control for gas-phase reactions can be solved by the use of standard flow instruments properly integrated to give the required material quantities. A flow transmitter sending an output signal to a ratio flow controller establishes a fixed point for the primary stream which balances against the secondary-stream flow. A monitor control, such as temperature point or gas analysis, provides a means for maintaining the proper portions of feed components for maximum reaction efficiency. The output from the monitor positions the balance point between the flow-transmitter outputs and results in a flow change of the secondary streams to keep the process balance. The schematic arrangement is shown in Fig. 2.

### Use of Strain Cell for Pressure Control

The problem of controlling piping-system pressures above those of normal operations with fast speed of response was solved by the use of a strain cell. The process encountered was such that normal lags in transmission

[1] Authors are, respectively, Acting Group Leader, Instrument Section; Instrument Engineer; Inorganic Project Manager; Process Design Manager.

Contributed by the Petroleum Division and presented at the Petroleum Mechanical Engineering Conference, New Orleans, September 25–28, 1955, of THE AMERICAN SOCIETY OF MECHANICAL ENGINEERS. Based on ASME Paper 55—PET-4.

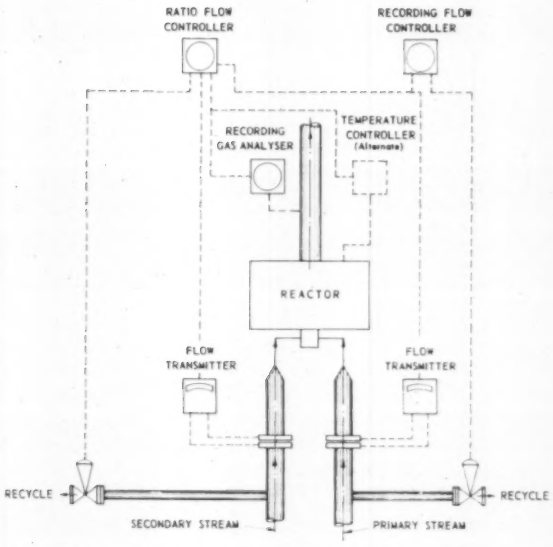



**Fig. 2 Schematic arrangement of ratio flow control for gas-phase reactions**

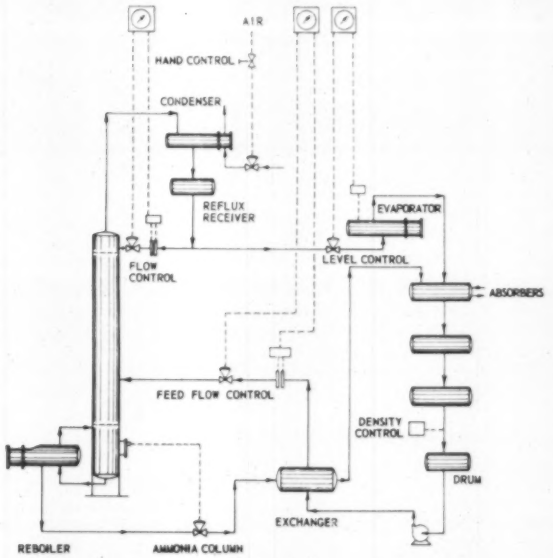



**Fig. 3 Diagram of key points for control of absorption refrigeration system**

from the primary element and final control loop could not be tolerated. It was also desirable that the primary element detect minute pressure changes. The controller was required to position a pneumatically operated control valve, set another controller, and to supply alarm and interlock-device contacts.

To fulfill this requirement, a resistance strain pressure cell was chosen as the primary device. The receiving instrument was one of the electronic type calibrated with a suppressed reading; that is, full scale is used for recording only a portion of the resistance change of the strain cell. The output of the receiving instrument is a pneumatic signal, which is converted to an electrical signal. This in turn reverts to a pneumatic signal near the pneumatically operated control valve. By using this system, long pneumatic control lines are replaced with one pair of electrical conductors, and it is necessary only to supply electrical power at the pneumatic-to-electric signal changer. This method of converting from a pneumatic signal to an electrical value for transmission, then back to pneumatic, was handled by the use of an electronic pressure transmitter and servoelectrical pneumatic transducer.

### Control of an Absorption Refrigeration System

Absorption systems utilizing ammonia have been in industrial-refrigeration service for many years. In general, they are an economical source of moderately low-level refrigeration when the tonnage capacity exceeds 200 to 300 tons.

Experience with the control of these systems indicates that the application of good instrumentation principles will give a satisfactory system.

The suggested key points of control for such a system are indicated in Fig. 3, with supplemental control to be added at the preference of the operator.

Starting at the distillation column which strips water from an aqua solution, producing refrigeration-grade ammonia overhead, there is installed a flow control for reflux in contrast to some recommendations of differential temperature control. This is primarily due to an insufficient concentration change and corresponding negligible temperature differences, and the unpredictable effects of subcooling. Differential temperature undoubtedly would work satisfactorily for systems subject to wider fluctuations in overhead purity. To use a flow control in such a system requires the elevation of the overhead condenser sufficiently high to allow a small working head for the control valve.

Flow control of the feed, and level control of the forwarding bottoms has proved quite satisfactory. This is in contrast to recommendations which would operate the feed by level control and flow control the forwarding bottoms.

Remote, pneumatic, hand-flow control of the cooling water to the overhead condensers of the column allows the control operator to maintain a uniform temperature and corresponding pressure on the system without some of the disadvantages which have been observed for automatic controls maintaining constant temperature of outlet liquid.

The control of the density of the strong aqua produced in the absorbers has proved to be quite satisfactory. The only other real control point is the liquid anhydrous ammonia as it is pressure-regulated or level-regulated into the evaporator utilizing the refrigeration of the system.

The balance of the system will naturally contain temperature, pressure, flow, and perhaps level indication points for aiding the operator, but these are not the principal points which determine the operating balance of the system.

### The Sealed Meter

Metering a highly corrosive liquid flowing at a high rate has been solved by the use of a sealed differential-type meter. Normally, corrosive flow measurement is

handled in one of two ways—either with the use of a rotameter or with a purged flowmeter.

The cost of a large-size porcelain rotameter with a suitable corrosive-resistant float seemed rather high; therefore it was believed that a more economical metering system could be designed.

Investigation revealed that a standard force-balance-type small-displacement meter could be so sealed as to prevent the corrosive liquid from coming in contact with the meter. Various designs of a sealed-meter installation were studied.[2] The one believed to be generally acceptable is shown in Fig. 4. The main components of the installation are as follows:

1 A force-balance meter transmitter.
2 Two seals with diaphragms of suitable corrosion-resistant material.
3 Two dutchmen (spacers).
4 An orifice plate.
5 Necessary valves and piping.

With reference to the diagram, it is well to point out the following:

1 Each seal diaphragm area is larger than the area of the diaphragm in the meter.
2 The seals should be at the same elevation; if not, an error will be introduced in the meter.
3 From meter to seal, the line is filled with ethylene glycol or similar material.
4 A flange designed from angle iron replaces the usual flange on the dutchman side of the block valve. This was done to utilize a straight-through pressure tap and to improve the mechanical strength of the valving at the dutchman.

The accuracy of the foregoing metering arrangement depends upon the care of installation and upon the care of sealing the meter. If installed correctly, the accuracy should be 1 to 3 per cent.

### Flow Measurement of High-Pressure Gas Streams

*Impeller-Type Flow-Sensing Cell.* The problem of measuring and recording process-gas flows at pressures above those normally encountered was the subject of recent study. During the early stages of design, various methods of flow measurement were investigated with the impeller-type flow-sensing cell appearing to have the primary device characteristics required. It was desired to measure and record two flows on a single recorder chart with a choice of selection of either one of the flows as a pneumatic control device. Since the controller was to be located in an electrically hazardous area, this prevented the use of an electronic instrument.

The problem was handled by the use of flow cells, Fig. 5, as primary elements installed directly into the high-pressure piping. The output voltage from each cell was fed into converters, then through electrical conductors into electropneumatic units located near the main control-instrument panel. These units are of the servoelectrical pneumatic transducer type which convert microamperes into pneumatic pressure signals. By using this scheme, the pneumatic pressure signals were fed directly into a conventional two-pen recording-receiver controller with control point being manually selected by the operator.

[2] Acknowledgment is given the Dow Instrument Maintenance Department for help on this problem.

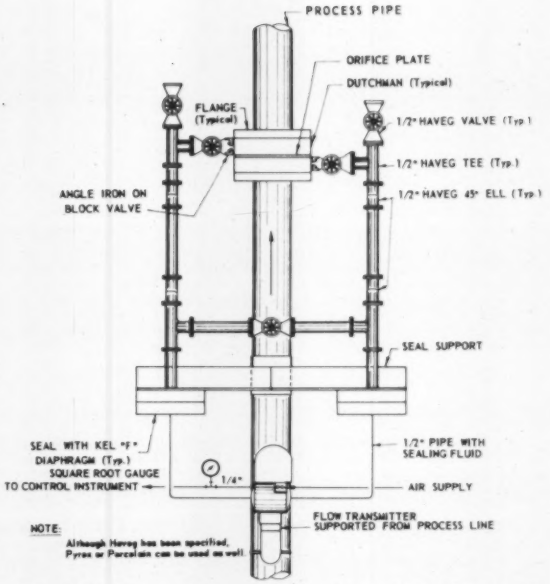

PROCESS PIPE
ORIFICE PLATE
DUTCHMAN (Typical)
FLANGE (Typical)
1/2" HAVEG VALVE (Typ.)
1/2" HAVEG TEE (Typ.)
1/2" HAVEG 45° ELL (Typ.)
ANGLE IRON ON BLOCK VALVE
SEAL SUPPORT
SEAL WITH KEL "F" DIAPHRAGM (Typ.)
SQUARE ROOT GAUGE TO CONTROL INSTRUMENT
1/4"
1/2" PIPE WITH SEALING FLUID
AIR SUPPLY
FLOW TRANSMITTER SUPPORTED FROM PROCESS LINE
NOTE:
Although Haveg has been specified, Pyrex or Porcelain can be used as well.

Fig. 4 Main components of sealed-meter installation for metering corrosive liquid

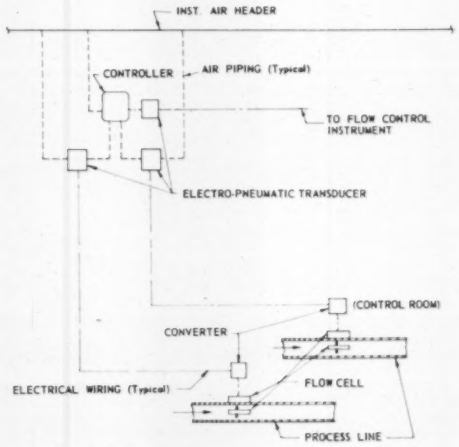



Fig. 5 High-pressure flow-cell installation for measuring and recording process-gas flows

### Conclusion

Although it is recognized that the examples given may be known to some engineers active in instrument work, we believe that they do serve to emphasize the interest of petrochemical companies in this subject. It is a common experience to find the most recent instrument developments on trial in various systems as much as a year or more before a formal announcement is made relative to the availability of the device. The instrument engineer is an important part of the successful operation of the highly instrumented petrochemical plants being built today. With the continued close co-operation between manufacturer and user, many tough problems of today will undoubtedly be solved tomorrow.

# How to Improve Profits—

## *A Challenge to Engineering*

**By Kenneth L. Block**

Management Consultant, A. T. Kearney & Company, Chicago, Ill. Member ASME

ONE of the most direct ways to improve profit is to reduce costs. The engineering department shares the responsibility for accomplishing this objective. This department can contribute to profit improvement by: (1) action which reduces costs in other departments; (2) action which reduces costs in the engineering department.

### Reducing Costs in Other Departments

The basic manufacturing and/or procurement cost of any mechanical or electrical product is usually established by the time it leaves the drafting board. Regardless of the efficiency which tooling or purchasing manages to achieve later, the designer may have set limits beyond which relatively little improvement can be made. The total design effect on manufacturing costs may be as much as 35 per cent of the total material, labor, and burden cost. Therefore one of the basic responsibilities of engineering management is to show engineers how to apply economic principles to all phases of design. There must be a constant effort to simplify design in order to lower the cost of the product.

Low-cost methods of designing depend upon a wide knowledge of basic methods of manufacturing and of the specific machines and tooling in the particular company. Close supervision is required to insure that each part and product is engineered to minimum manufacturing cost compatible with required quality and performance.

***Design Rules.*** Some good rules to follow in designing for low cost are as follows:

1 Design for maximum simplicity of all functional characteristics and sturdiness required in the end product.
2 Ask yourself, "Is it absolutely required?" If possible, eliminate the part or consolidate it with others.
3 Design for most economical production method consistent with quality and quantity of output required.
4 Select the lowest-cost material which will fit the foregoing requirements.
5 Design for minimum finishing operations.
6 Design for ease of holding and setting up or handling the parts.
7 Specify finish and accuracy to no greater tolerances than are necessary.

In an attempt to realize all possible savings in this area, some companies have set up a product-engineering group which adapts the original design to lowest shop costs consistent with necessary requirements for quality and quantity of output. Other companies have asked the manufacturing and purchasing departments to suggest changes in design which would save money through changes in process or the substitution of material.

***Service Life.*** Some engineering departments have reduced the manufacturing cost of parts and subassemblies by insisting that each part and assembly be designed consistent with the service life of the end product. In one instance, where this principle was not kept in mind, an engineering analysis disclosed that parts and subassemblies used in a finished product with a life of 10 years were designed with probable service usage of anywhere from a minimum of two years to a maximum of 87 years. The excess life designed into some of the parts increased costs; the too-short life designed into other parts was bound to lead to customer dissatisfaction.

***Standardization.*** Standardization of parts can reduce costs in other departments. Some companies set up a "standard-parts book" in which they list permanent part numbers of commonly used parts, such as hardware and fittings. Management approval is required for design and use of any hardware or fittings not listed in this book.

Standard parts are purchased or manufactured in economic lot quantities and placed in stock. This saves the cost of separate purchase, receipt, inspection, and accounting on smaller purchase orders for a varity of special parts. It also saves shop-ordering cost, setup cost, and handling cost on manufactured parts.

***Maximum Tolerances.*** The intelligent use of engineering tolerances can decrease the cost of a part and minimize scrap. The designer should always ask himself, "Would we have to scrap this part if tolerances were increased $\pm 0.001$ in., or $\pm 0.002$ in.?" If the answer is "no," he should incorporate these additional limits in his tolerances. It is especially important to keep tolerances loose for ease in assembly. Selective fitting on the assembly floor increases costs tremendously.

The statistical quality-control department is often of great help where close tolerances lead to excess cost and result in excess scrap.

***Engineering Change Orders.*** Engineering change orders often increase the costs in other departments needlessly. Changes are generally issued to correct an engineering error, to reduce costs, to simplify manufacturing, or to improve serviceability. Many changes are made without adequate analysis of the cost of disposing of obsolete inventory and tooling. Changes should be put into effect only if the over-all cost and savings picture is favorable, or if they affect safety or the reputation of the company.

### Reducing Engineering-Department Costs

The previous section has pointed out ways in which the engineering department can be instrumental in effecting savings in the shop, purchasing, tooling, production control, cost and accounting, inspection and

Presented at the 1955 prize-paper contest for younger mechanical engineers, conducted by the Chicago Section of THE AMERICAN SOCIETY OF MECHANICAL ENGINEERS. This paper received first prize. (The paper has been condensed slightly.)

industrial-engineering departments. There are many ways in which the engineering department can reduce costs through proper organization and administration of its own department.

***Organization.*** The engineering department should be organized so that work will be completed on time and at the lowest possible cost within the department. Proper organization structure depends upon the size, function, and personalities of the engineering department. In general, however, the service activities should be separated from the design and production engineering activities. Reduction in cost can often result from proper utilization of technically qualified design engineers on design work and less technically trained people for service work.

***Planning and Scheduling.*** Low-cost operation of an engineering department calls for proper planning and scheduling of work. The time to complete each engineering project should be estimated in advance and compared with the manpower hours available during calendar periods by specific types of engineering work. This determines whether the requested data for the project can be met. If this is impossible on a normal basis, it is necessary to take corrective action through overtime work, subcontracting of engineering work, or the addition of more engineers.

A report should be issued at the end of the project showing the actual hours expended on the job related to the estimated hours. The validity of the estimate can be easily checked and corrective action taken in regard to future estimating.

But usually this action is not enough for proper control. We want to know as soon as a job starts to overrun the estimate so that corrective action can be taken while the project is in process. This action is accomplished by relating the hours actually expended to date to the percentage of completion of the job applied to the estimated hours. If actual hours are greater than estimated hours, investigation should be started immediately to determine the reason why, and whether corrective action can be instituted.

If the estimate for the project is an addition of separate estimates by specific jobs or types of work within the project, actual hours expended should be gathered on the same basis so that a more exact picture can be gained as to where the project is overrunning. Some companies use a visual graph to plot actual progress against scheduled progress for each job as of the current date. This is used as an aid in controlling the cost of the project.

***Cost Controls and Budgets.*** One of the best ways to determine the engineering cost of any project is to use a time-charge system which will allocate every hour of each engineer's time to a proper breakdown within each project. These hours, multiplied by the engineering cost per hour of the engineer's time plus engineering overhead allocated to those hours, give an accurate breakdown of the total cost of the job or the cost of any part of the job. This engineering develops a backlog of information useful in estimating the cost of new projects.

***Personnel Control.*** Employee efficiency is directly proportional to employee morale. Therefore an intelligent engineering-personnel program is necessary. Such a program should include provisions for simple practical methods of procurement, the handling of complaints and terminations, the assignment of personnel to operating programs, the maintenance of history records, and the administration of wages and salaries.

## The Challenge

**Your engineering department can start putting into effect some phases of this profit improvement program immediately without having to get top-management approval. When existing policy matters or major expenditures are involved, top-management approval should be obtained. Usually an estimate of returns for a given expenditure will be more convincing in obtaining such approval. The suggestions made in this paper tend to reduce costs in the shop, the purchasing department, the inspection department, the production-control department, the industrial-engineering department, and the tooling department. Proper organization and management control of the engineering department will lead to many economies in its operation. The reduction of costs in this manner by the engineering department will improve the profit of your company and insure its long-time success.** ***Are you willing to face up to this challenge?***

Proper salary administration which is based upon job evaluation, as well as periodic reviews of job performance by the supervisor, his superior, and the engineering-department personnel manager, help greatly to insure increased morale within an engineering department.

***Standards.*** Several types of standards can contribute to efficient operation of the engineering department: An engineering-procedures manual, a drafting-room manual, a design handbook, and a standards-parts book.

The engineering-procedures manual usually specifies the detailed procedures in use within the engineering department. These include policies and rules relating to working hours, vacation policy, rules of discipline, and other matters. Once a particular policy or procedure is written, it is easier to assure the conformance of the entire department.

A drafting-room manual describes company drafting practices. It is confined to information which the draftsman will require frequently and includes data on materials, design data, conversion tables, processes, and finishes.

The design handbook states the desired design methods for products manufactured by the company based upon equipment which is available within the company.

A standards book utilizes standards set up by government, industry, and commercial associations, and by the company itself. It specifies adherence to these standards. The establishment of a standards-parts book reduces cost by eliminating repeated detailing of small utility parts used in many designs by a particular company. Creation of design standards for items such as fastener installations, electric wiring, assemblies, conduit assemblies, and sheet-metal cutouts eliminates the constant repetition of extensive drawing notes and dimensioning.

***Simplified Drafting.*** Engineering drawings can be simplified by eliminating nonessentials, simplifying delineation, and stripping all frills which do not result in a loss of clarity or accuracy. In some cases this approach has reduced engineering time from 20 to 30 per cent.

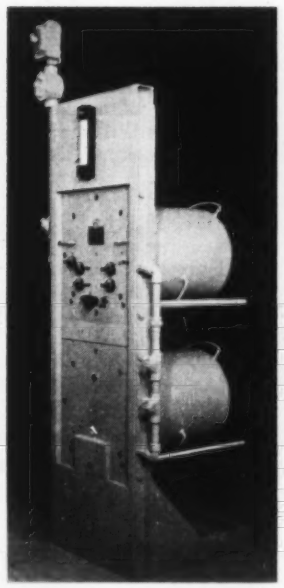


Fig. 1 Infrared analyzer containing programming system

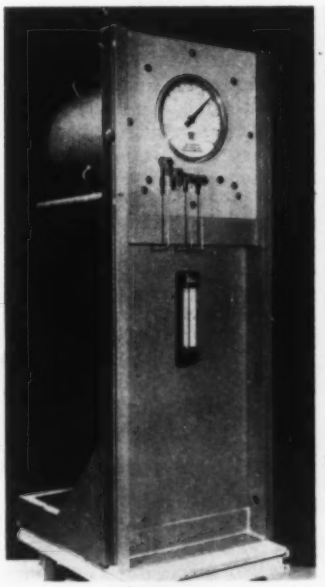


Fig. 2 Explosionproof differential refractometer

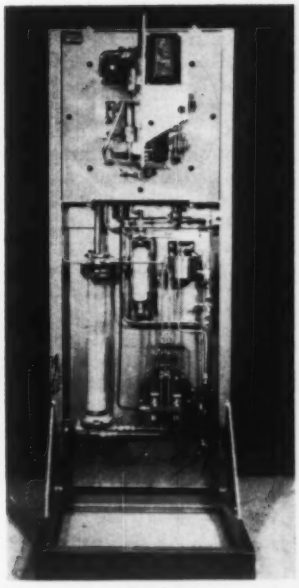


Fig. 3 Continuous oxygen analyzer and gas-scrubbing accessories

# Process Control by End-Point Analysis

## . . . and Associated Data-Reduction Systems

**Although few completely automatic control systems are in operation, instruments and data-reduction systems aimed at automatic control are available**

**By S. M. Rock[1] and Jack Walker[2]**

Process control by end-point analysis is not a new problem nor is it a new development with the coining of the term "automation." However, present techniques of instrumentation for end-point analysis and data handling leave much to be desired. This paper reviews the field and points out needs of the immediate future.

Present end-point analyses are being performed primarily in the laboratory by batch-sampling techniques. Continuous monitoring of end point will never completely replace this function, because most instruments designed for this purpose present only a partial analysis or follow a related physical property.

The instruments for end-point analysis of necessity will continue to evolve from the laboratory. This evolution is not always a clean-cut process since an entirely different philosophy exists between laboratory and plant-process instrumentation. The instruments to be discussed are in various points of this evolution process as shown in Table 1.

[1] ElectroData Corporation, Pasadena, Calif.

[2] Section Chief, Industrial Process Control, Consolidated Engineering Corporation, Pasadena, Calif.

Contributed by the Instruments and Regulators Division and presented at the Joint ASME Instruments and Regulators Division–ISA Conference, Los Angeles, Calif., September 12–16, 1955. Condensed from ASME Paper No. 55—IRD-9.

### End-Point Analysis Equipment

These instruments are divided into two classes for discussion purposes. Physical instruments are those whose principle of operation is strictly a physical property of matter. Chemical instruments are those whose output is a function of chemical separation or molecular structure. Like instruments for the measurement of temperature, pressure, and flow, the physical instruments shown in Table 1 seem to have made the transition from the laboratory to the plant in the greater number. The reason for this status is fairly obvious. Since in general a greater economic return is realized on a liquid product than a gaseous one, these instruments have shown a more rapid pay-out in spite of the limited information in return. The operating principle in general is simpler with resultant better reliability. Less fre-

quent batch laboratory sampling is needed, and no computing is required, where a 1:1 correlation of quality versus control exists.

***Examples of Typical Instruments.*** Fig. 1 is an infrared analyzer, which introduces a new concept in end-point analyzers. The unit is completely explosion-proof, and contains a sample programming system.

Fig. 2 is a similarly housed differential refractometer. This instrument finds many uses in refinery liquid-still control, gasoline blending, and chemical production.

Fig. 3 shows a rear view of a continuous oxygen analyzer with related gas-scrubbing accessories. This instrument is capable of detecting 10 ppm of oxygen in gas streams.

Fig. 4 is a continuous portable sulphur analyzer, capable of detecting sulphur in the form of hydrogen sulphide and/or mercaptan in the parts-per-million range.

component gases with appropriate zero suppression and span calibration on a synchronized time schedule.

Scanners are still other means of recording the working functions of such end-point controllers. This is a new approach to the general problem of miniaturization. Future control-panel installations will incorporate scanners to merely check variables such as temperature, pressure, flow, and composition on a prearranged time schedule. Each variable will be compared to tolerable range limits. The output will be switched to a recorder and/or alarm system only when the variable exceeds its preset limits. Scanners will thereby eliminate the necessity for multiple direct-indicating recorders, meaningless records, and the attention of an operator.

***Digital Accessories—Pilot Plants and Test Facilities When Data Are the Product.*** Logging is a development currently being explored in conjunction with analog-to-digital

**Table 1 Status of End-Point Analyzers**

| | Laboratory | | | Monitoring | | | Control | | |
|---|---|---|---|---|---|---|---|---|---|
| | Gas | Liquid | Solid | Gas | Liquid | Solid | Gas | Liquid | Solid |
| Physical instruments: | | | | | | | | | |
| Conductivity | x | x | | x | x | | x | x | |
| Refractometer | | x | | | x | | | x | |
| pH | | x | | | x | | | x | |
| Viscosimeter | | x | x | | x | | | x | |
| Dielectric const | | x | x | | x | x | | 0 | |
| Beta ray | x | | x | | | x | | | x |
| Chemical instruments: | | | | | | | | | |
| Infrared | x | x | x | x | x | | x | 0 | |
| Ultraviolet | x | x | | x | 0 | | x | 0 | |
| Mass spec | x | x | x | x | 0 | | 0 | 0 | |
| Emission | | x | x | | | | | | |
| Sulphur | x | x | | x | | | 0 | | |
| Oxygen | x | | | x | | | 0 | | |
| Chromatography | x | x | | 0 | | | 0 | | |

x = Present application.
0 = Immediate-future application.

**Table 2 Evolution of Control Accessories for End-Point Analyzers**

Analog accessories:
1. Recorders—monitors
2. Programmers
   - (*a*) Multistream
   - (*b*) Multicomponent
3. Computer—controllers
4. Scanners

Digital accessories:
1. Logging—(analog to digital recording)
2. Transmitter
3. Digital computer

Fig. 5 shows the latest design in miniature mass spectrometers. This instrument is capable of laboratory batch analyses or continuous-stream analysis in the hydrogen through gasoline range.

***Instrument Accessories.*** Few standard systems are available today to integrate the end-point analyzers and the control loop. In the final analysis several control loops may be contained within the whole system. Both analog and digital devices are necessary in the normal evolution of process control. These accessories are listed in Table 2 in the general order of their evolution.

***Analog Accessories.*** Analog devices are presently being used with end-point analyzers to monitor and control processes. These devices undoubtedly will continue to be used because of their simplicity, adequate accuracy, and response time.

For example, most of the instruments mentioned are provided with analog pen-and-ink recorders for monitoring stream composition. Automatic zero suppression and span standardization are available on infrared and ultraviolet analyzers. When these devices are used in conjunction with standard recorder-controllers with proportional control, reset and rate response, the role of the analog computer is being filled.

Programmers are in general a class of devices used to schedule events of multistream multicomponent analyzers, and the related analog control functions. Infrared analyzers and mass spectrometers have accessory devices to sample up to five different streams and six

converters. "Logging" is the process-industry equivalent of the automatic data-handling or data-reduction systems of the aviation industry. Various forms of analog-digital converters are being used to record process variables in the form of a typewriter log sheet, punched-tape, and IBM cards. In conjunction with these units, scanners are described to effect alarms, print-out "off-spec" data in red, and so on. Logging and scanning devices are a means of presenting accurate co-ordinated plant information to plant personnel, research, digital computers, and management.

## Computers in Process Control

As is shown in Table 1, which summarizes the status of control utilizing various analytical methods, most laboratories are still using batch analysis for the more complicated streams. Similarly, in the uses of computers at the present state of the art, the problems are more often done on a batch basis than as part of a continuous system. Instrumentation is evolving so that the points at which human interpretation and intervention are required are decreasing, but they are far from eliminated. As long as there are batch analyses, there must be batch computation.

***General Digital Computations.*** Present digital computers perform such batch analyses and many other computations very rapidly. The digested data from the computer is fed back to the interested departments who

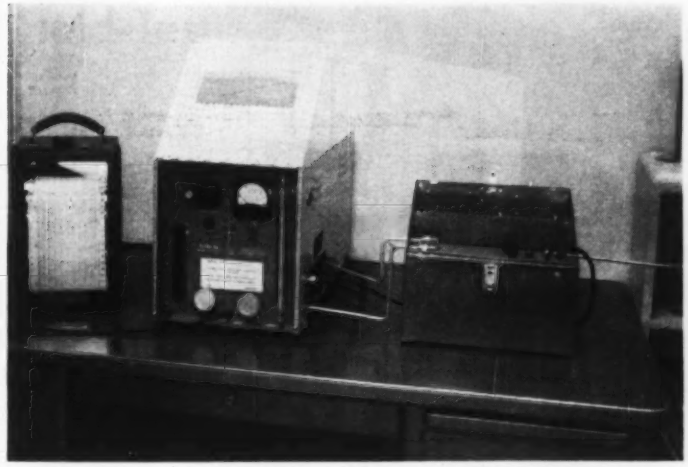


Fig. 4 Continuous portable-type analyzer for detecting ppm of sulphur components

Fig. 5 Continuous monitoring mass spectrometer

examine the information and interpret it in terms of the control needed. The data also may be stored and later recombined as needed into fuller reports to laboratories and management.

*Computations of Analyses.* Among the control analyses now being computed in large numbers, are those analyzed by the mass spectrometer. About 40 to 60 samples per shift can be turned out in routine gas analysis. With currently available equipment, such as Consolidated's SpectroSADIC, the data for each mixture may be punched into cards or a paper tape which is the direct input medium for the computer. The analyses are computed much faster than they can be run on the mass spectrometer. So the laboratory collects perhaps half a day's runs on perforated paper tape, or on punched cards. These are sent to the computer, and reports produced at a rate of about one per minute. The results are sent back to the laboratory in final report form. They also are stored either in the computer, on magnetic tapes, or on punched cards for later combination with other data.

After all analyses have been completed for the pertinent period, interrelated data are processed. For example, the various mass spectrometer, infrared, and other spectrographic analyses may be combined with fractionating column analyses and pressure and flow data to compute composition of the incoming crude. The pertinent information needed for process control is still interpreted by the human links in the chain. The analytical data are available in the memory of the computer to combine with other information to send reports to management.

*Description of General-Purpose Digital Computer.* A general-purpose computer suitable for analytical computations and a variety of other computational and data-processing functions must incorporate certain basic features: Primarily, it must have various input devices, compatible with its speed of computation. Speed of operation, in terms of the problems of greatest interest, and flexibility in solving different problems must be adequate. Closely connected with speed and versatility is the capacity and speed of the memory or storage. Most machines now on the market store about 1000 to 4000 "words" or numbers. Some machines operate in decimal arithmetic, some in other number systems. The instructions which the machine is capable of carrying out must be sufficiently useful and varied to minimize programming complications. The instruction list or program for any problem should be stored internally, and the machine should be capable of altering its own instructions and choosing its instructions from different points, depending on number magnitude.

One system now in use in refinery calculations is the ElectroData DATATRON. This machine, shown in Fig. 6, operates in the decimal mode on ten-digit numbers or words. Additions, subtractions, and most basic operations are performed at an average rate of somewhat less than 500 per sec. Either perforated paper tape via a high-speed photoelectric reader (540 decimal characters a second) or punched cards (200 cards per min) may be used as input. Output is to a summary punch (100 cards per min), a typewriter or punch (one word per sec). The capacity of the magnetic drum memory is 4000 words, plus 80 words of quick-access memory from which orders are executed and data called during computation.

To illustrate problem performance, a $20 \times 20$ matrix may be inverted and checked in 12 min. A 21-component wet-gas mixture can be analyzed in 13 sec comparing with about 45 min on a desk calculator. These figures are the actual computation time. Output time depends on the method used and the format and number of items to be printed.

The machine illustrated can be used with perforated tape, typewriter, punched cards, or a line tabulator as the report-writing output. The day's output from two or more mass spectrometers would take two hours or less on this machine.

*Formulation Required.* As we have said, this and similar machines have a speed and capacity greater than needed for any one analytical job, and are now used on batch computations. The machine is not yet programmed to assume the routine decisions of either the control engineer or the management. The chief reason is that the pattern for these decisions is not yet generally formulated. This word "formulated" contains the key to why a great many things have not yet been done by com-

**Fig. 6 Electrodata Datatron computer installation at Magnolia Petroleum's Field Research Laboratories, Dallas, Texas, showing computer, console, flexowriter, and power control**

puters. Before the computer can be programmed to do any operation, that operation must be thoroughly understood and expressed as a logical fully defined sequence of computations and decisions. Automatic-control loops are closed only where the variable having the greatest effect is known, where the point at which the control is highly effective has been determined, and where the relation between the two is established. In such simple cases the computation required is seldom more than a comparison with a standard, which can be done by a small device rather than a large data processor.

The batch computations now still being done in all aspects of refinery operation are providing the information for fuller understanding of larger loops and subsequent formulation of their operation in terms of specific measurements and control factors. With this expanded know-how, larger programs will be drawn to incorporate some of the work now being done by the engineers and members of management. As formulation evolves, larger and larger portions of the operation can be controlled by fewer adjustments. When the large batch problems are routinely solved and are thoroughly proved, systems may incorporate several small loops with their own special-purpose computers. Selected output from these may be fed in sequence into a large computer. This computer will then combine the partial data, and, on the basis of the computed results, drive some of the controllers themselves. Until the gaps in present knowledge are filled in, and the formulation advanced, this is not feasible.

***Small Computers.*** A much more imminent step will be the closing of a number of smaller loops—bigger than those now in effect, but still a considerable distance from the automatic plant. For these, in many cases, the special-purpose machines, many of them analog rather than digital, will be in use. One immediate need here is on the monitoring mass spectrometer. A small computer which does nothing but compute percentage composition from mixture spectra can be specified and is almost immediately feasible. It must analyze mixtures at the rate of about one every 5 to 10 min. It need have an accuracy of about 3 to 4 digits only, which may be obtained on analog or digital equipment. Special streams, where one peak is unicomponent and other peaks can be sequentially corrected by programmed zero suppression and attenuation, can now be monitored, using equipment in the $3000 to $5000 range. Obviously, in any application, the simplest, most reliable, and cheapest computer should be adopted—and at the moment this may well be the analog machine in many cases.

### Further Development Needed

Present equipment is adequate to close some small well-defined control loops usually based on one measurement and one control point. The immediate prospect is for extension to more components, and possibly more versatile and powerful special-purposes computers directly coupled with the analyzers. Batch analysis is being employed on more and more complex mixtures, and control data are being defined more effectively. As knowledge increases, the size and complexity of the loop will be increased, but much time and effort must first be spent in:

(*a*) Further development of inexpensive and reliable analytical devices.

(*b*) Further development of auxiliary equipment for sampling the products, programming the analyses, and producing input and output data in suitable form for reduction.

(*c*) Formulation of the control problem so that a data processor or computer can be specified for the loop.

(*d*) Development of more auxiliary equipment to feed output from the data processor to the correct control point and actuate them as required.

The evolution may be slower than is now expected by the more optimistic designers.

# Field-Testing a Reversible Pump-Turbine

## Flatiron Power and Pumping Plant unit delivers efficiencies of 91 per cent pumping and 88.8 per cent generating

**By Frank E. Jaski**

Engineer in Charge, Pump Turbines, Hydraulics Section, Allis-Chalmers Manufacturing Company, Milwaukee, Wis. Member ASME

An efficiency test of the reversible pump-turbine at the Flatiron Power and Pumping Plant, Bureau of Reclamation, was made in June, 1954, with flow measurements by the salt-velocity method. This is the first reversible pump-turbine designed, built, and installed in the United States. This paper describes the unit and method of performing the tests, and includes results of the tests for pumping and turbine operation.

The objectives of the tests were as follows:

1 To measure the discharge, horsepower input, and determine the efficiency of the unit, when operating as a pump at various total dynamic heads.

2 To determine horsepower output, discharge, and efficiency of the unit operating as a turbine over a range of net heads.

3 A series of readings for calibrating winter Kennedy taps and differential head across the butterfly valve were made, for flowmetering purposes.

### Description of Unit

The Flatiron reversible pump-turbine is a vertical unit, which operates as a centrifugal pump when revolving in one direction, and as a turbine when revolving in the reverse direction. It is driven by an electric motor, which works as a generator when driven by the turbine. Fig. 1 shows a cross section of the unit. It has a Francis-type bronze impeller-runner, 101.25 in. diam, which has six buckets. It has a welded-steel spiral case, with welded stay ring, containing ten fixed vanes. The spiral-case nozzle is 60 in. diam. At the nozzle entrance is a 76-in. butterfly valve, hydraulically operated by oil pressure at 1000 psi. The pump-turbine does not have movable wicket gates, and does not have a governor. The top and bottom cover plates are welded steel. An elbow draft tube formed in concrete also serves as a suction tube for pumping, and has a steel liner at the top. A rack at the draft-tube outlet prevents large trash from entering the unit when pumping.

A large concrete box at the bottom of Carter Lake acts as a discharge outlet of the tunnel when pumping, and is the intake during turbine operation. It is provided with rack bars on the top and on three sides.

Contributed by the Hydraulic Division and presented at the Diamond Jubilee Annual Meeting, Chicago, Ill., November 13–18, 1955, of The American Society of Mechanical Engineers. Slightly condensed. Paper No. 55—A-29.

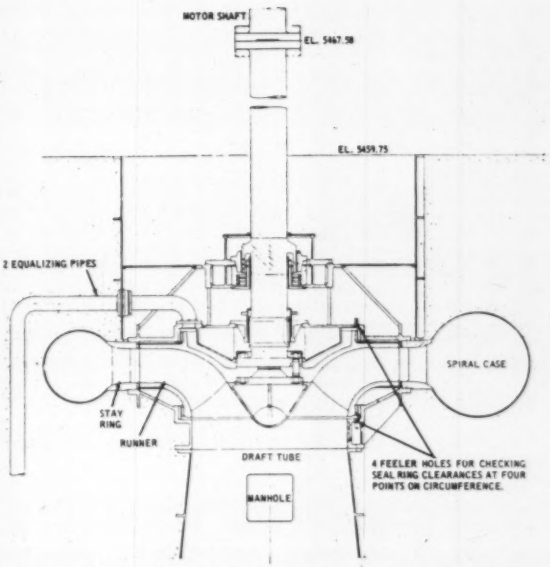



**Fig. 1 Cross section of pump turbine at Flatiron Power and Pumping Plant**

The main shaft has a self-lubricating-type oil bearing, such as is used on many vertical generators. The bearing shell is babbitted and has oil grooves sloping clockwise and counterclockwise, for oil flow upward, with rotation in either direction. A stuffing box with graphited packing surrounds the shaft below the bearing.

The unit is designed to run counterclockwise at 300 rpm when pumping, and discharge 370 cfs against 240 ft total dynamic head. The pumping head varies between 170 and 300 ft.

When operating as a turbine, it runs clockwise at 257 rpm and is rated 9200 hp at a net head of 250 ft. The net head on the turbine varies between 290 and 140 ft.

This unit was designed and built for operation at two speeds, because higher efficiency and more horsepower are obtained as a turbine at a lower speed than the pumping speed. This is the first unit of its kind built for two-speed operation, and a generator motor of special design was built for this purpose. The pump-turbine, generator-motor, and switchgear for the unit were designed and furnished by the author's company.

In some applications it is possible to obtain a larger horsepower output and better efficiency from the turbine if it is operated at a lower speed than the pump. Fig. 2 shows a comparison of performance curves for the Flatiron pump turbine when operating as a turbine at 300 rpm and 257 rpm, as stepped up from the model tests. The horsepower is stepped up for the ratio of prototype to model, and the efficiency is the model efficiency obtained in the laboratory tests. It will be noted that, at heads below 280 ft, the horsepower at 257 rpm is larger than at 300 rpm, and at heads below 260 ft, the efficiency is higher than at 257 rpm.

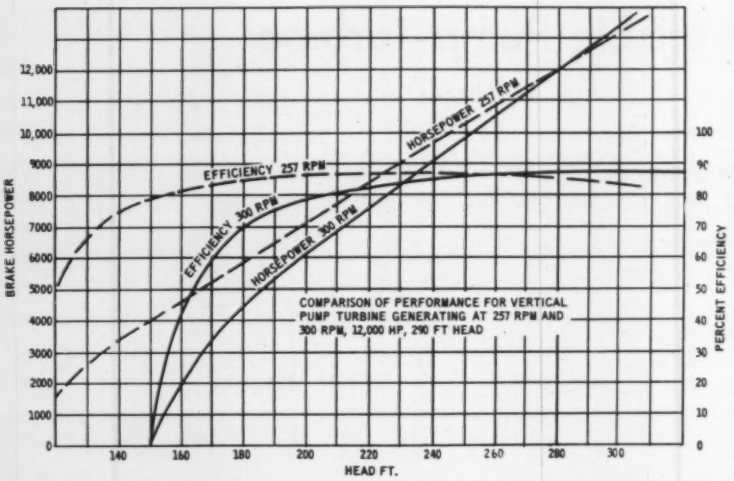

BRAKE HORSEPOWER
PERCENT EFFICIENCY
HEAD FT.
EFFICIENCY 257 RPM
HORSEPOWER 257 RPM
EFFICIENCY 300 RPM
HORSEPOWER 300 RPM
COMPARISON OF PERFORMANCE FOR VERTICAL PUMP TURBINE GENERATING AT 257 RPM AND 300 RPM, 12,000 HP, 290 FT HEAD

**Fig. 2** As a turbine, efficiency and horsepower output based on model tests are compared at two operating speeds

### Location of Plant

Flatiron Power and Pumping Plant is the last in a series of plants of the Colorado Big Thompson Project utilizing water diverted from the western slope of the Continental Divide to the eastern slope by means of the Alva B. Adams tunnel. The water is used for irrigation, hydroelectric power, and other multipurpose benefits. It is located at the base of Bald Mountain, approximately 10 miles west of Loveland, Colo., or about 50 miles north of Denver. It is a peak-load plant, and contains two conventional Francis turbines and the reversible pump-turbine. The water used for generation also may be subsequently used for irrigation. To release water for irrigation throughout the year and independent from seasonal irrigation requirements, two storage reservoirs have been provided to receive the water discharged from the Flatiron Plant. One of these is the Horsetooth reservoir north of the plant, into which the tailrace discharges through a feeder canal. The other reservoir is Carter Lake, located about 1 mile south of the plant, into which water is pumped from the Flatiron tailrace by the reversible pump-turbine.

The pump discharges through a 76-in. butterfly valve into an 8-ft steel penstock and concrete tunnel with its outlet at the bottom of Carter Lake. A second butterfly valve is located in the tunnel about 6000 ft from the plant, to provide a means of draining the tunnel for inspection. A more complete description of the design features of the power plant is given by John Parmakian.[1]

### Starting and Stopping the Unit

It was established during the model tests in the laboratory that it would be feasible to start up the turbine with a butterfly valve and hold the speed steadily at synchronous speed to synchronize the unit with the system. This was confirmed by further test by the manufacturer on a full scale on one of the 21,000-hp Francis turbines operating under 482-ft head at the Estes Power Plant of the Bureau of Reclamation.

The Flatiron unit is started as a turbine by opening the 76-in. butterfly valve a small amount, which accelerates the unit up to speed just below 257 rpm. The 6-in. motor-operated by-pass valve is opened gradually, until the speed levels off at 257 rpm, and the circuit breaker is closed. The butterfly valve is opened to its full open position and remains wide open while the unit is carrying load and the by-pass valve is closed. It operates just like a Francis turbine that is running at a fixed gate opening, and the turbine output is dependent upon the head existing at the time of operation.

When starting up for pumping, the butterfly valve is in full closed position. The water in the spiral case and runner is blown down by compressed air at 100 psi, to a level about 2 to 3 ft below the bottom of the runner. This can be done in about 10 to 15 sec. A float valve attached to the side of the draft tube then maintains the water level by bleeding in just enough air to hold the level within a very small range. The motor is started up with the runner revolving in air, and when it reaches 300 rpm, the air is expelled from the spiral case through a solenoid valve at the highest point of the butterfly-valve housing. The air can be expelled from the unit in about 30 to 40 sec. Then the spiral case fills with water, and the unit is running at shutoff head. After all air is expelled, the butterfly valve is opened to full open position, and the pump discharges water against a total dynamic head existing at the time of starting. The butterfly valve remains wide open while the unit is pumping.

The pump is shut down by closing the butterfly valve, and the circuit breaker is opened after the valve is in full closed position. The time for opening or closing the butterfly valve is about 3 min, 25 sec.

The synchronous generator motor is rated 13,000 hp, 3 phase, 60 cycles, 13,800 volts, 1.0 power factor, 300 rpm as a motor, and 8500 kva, 3 phase, 60 cycles, 13,800 volts, 257 rpm as a generator. A description of the electrical features of the generator motor is given in a paper by S. M. Denton and H. O. Britt.[2]

In the event of power failure to the generator or motor, the unit may reach a runaway speed in the turbine direction of about 500 rpm if the net head is at the maximum value of 290 ft. The pump-turbine and generator motor are designed to run safely at this overspeed.

### Performance Test Procedure

The tests were made under the direction of G. J. Hornsby of the Bureau of Reclamation, Denver Office. Electrical measurements were made under the direction of H. A. Pierce of the Flatiron Power and Pumping Plant. Salt-velocity measurements were made by L. J. Hooper. Allis-Chalmers Manufacturing Company was represented by F. E. Jaski and A. J. Thompson.

Two performance tests of the unit were made, the first test operating as a pump, and the second operating as a

[1] "Design Features of the Flatiron Power and Pumping Plant," by John Parmakian, MECHANICAL ENGINEERING, vol. 77, August, 1955, pp. 677–680.

[2] "Pumped Storage and Hydro Generation at Flatiron Power Plant," by S. M. Denton and H. O. Britt, AIEE Paper No. 55-164.

turbine. For the pump test, the minimum head was dependent upon the water level in Carter Lake. The dynamic head was then increased by throttling the flow with the butterfly valve in the tunnel about 6000 ft from the pump-turbine.

The 76-in. butterfly valve at the spiral-case nozzle remained wide open during the tests. Test runs as a pump were made at various dynamic heads up to shutoff head of 358 ft at zero discharge. All of these runs were made with the unit running at 300 rpm.

For the turbine tests, the maximum net head was dependent on the level of Carter Lake and the tail water. Only a limited amount of head variation was available at Carter Lake, but it was possible to vary the tail-water level over a range of about 9 ft. Because Carter Lake was only partly filled, the maximum net head that could be obtained during the test was about 227 ft. For runs at lower net heads, the butterfly in the tunnel was gradually closed to throttle the flow, and test runs were made down to a minimum net head of 174 ft. All of the turbine runs were made at 257 rpm. During the tests, the speed of the unit was determined by the frequency of the electrical system, and this was always maintained as closely as possible to 60 cycles per sec.

### Head and Discharge Measurements

For both pump and turbine tests, the pressure and velocity heads were determined at the spiral-case nozzle. At this point there were four piezometers across two diameters at right angles to each other, and 45 deg from the vertical. The average diameter of the nozzle was measured carefully, and the area calculated so that the velocity could be obtained for each run. The pressure at the nozzle was measured by a Crosby fluid pressure scale, provided by the Denver Office of the Bureau of Reclamation. This permitted readings of pressure to be made to the nearest 0.1 psi.

The tail-water elevation was measured in a stilling well connected to the tailrace. The elevation of the water surface in the stilling well was obtained with a steel tape and plumb bob, with a voltmeter indicating contact of the bob with the water surface.

For the turbine tests, the velocity head was computed at the end of the draft tube. The velocity head varied from 0.09 to 0.13 ft; hence it had no significant effect on the total net head. The elevation of Carter Lake was measured by a steel tape and plumb bob in a stilling well in the same manner as described for the tail-water measurements. This measurement allowed the loss in the tunnel and penstock between Carter Lake and the spiral-case nozzle to be measured during the runs in which the butterfly valve was wide open.

The total dynamic head on the pump was taken as the pressure and velocity head at the spiral-case nozzle, plus the elevation of the Crosby pressure scale minus the elevation of tail water.

The net head on the turbine was taken as the pressure and velocity head at the spiral-case nozzle plus the elevation of the Crosby scale minus the elevation of tail water minus velocity head at the draft tube exit.

The test section for the salt-velocity measurements was located in a long, straight section of 8-ft-diam concrete pipe. The brine-injection pipe entered the penstock through the cover on the manhole. The brine-injection pop valves were located at this station. For the pump test, a turbulator, Fig. 3, was installed on the plant side and 32 ft from the injection equipment. The turbulator

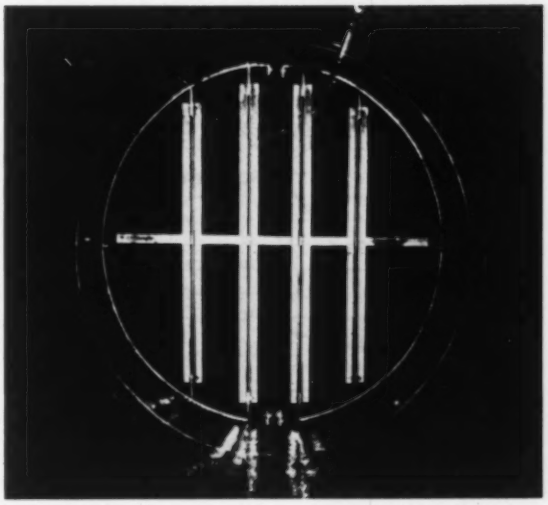


**Fig. 3 Turbulator installed in tunnel to obtain more uniform flow distribution**

disperses the water so that a more uniform velocity is obtained across the area of the penstock at the measuring section, and gives better distribution of the brine solution as it passes the electrodes, particularly at the lower velocities.

Two sets of electrodes were installed on the Carter Lake side of the injection equipment and at distances of 40 ft and 130 ft, respectively, from it. For the turbine test, the brine-injection valves remained at the same location. The turbulator was relocated 32 ft from the injection station on the Carter Lake side. The electrodes were installed 40 ft and 140 ft, respectively, from the brine-injection station and on the plant side.

The volume of the penstock between electrodes for each set of tests was measured carefully and computed in the field. The flow diagrams for each run were made on a Sanborn direct-writing oscillograph. The timing record on the Sanborn chart was operated by a Haydon d-c timing motor fitted with a chronometric governor. The timing device was calibrated before, during, and after the test, and found to have a constant rate within 0.01 per cent.

### Electrical Measurements

All electrical measurements for computing the horsepower output of the turbine and horsepower input to the pump were made by the following instruments:

(*a*) Two single-phase rotating standard watthour meters.
(*b*) Two single-phase indicating wattmeters.
(*c*) Station polyphase watthour meter.
(*d*) Two ammeters and two voltmeters.

All meters used in the test were calibrated before and after the tests. The instrument transformers were standard meter transformers.

At the beginning of each run, the head desired at the unit was adjusted by setting the butterfly valve in the tunnel to the proper opening. When the flow and pressure conditions became stable, the signal was given to be ready to start a run. The power factor was ad-

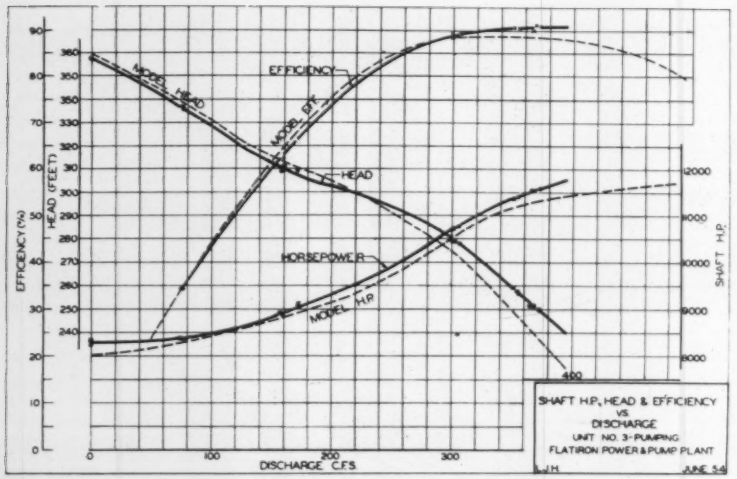



**Fig. 4** Curves showing the performance test curves for unit when operating as a pump

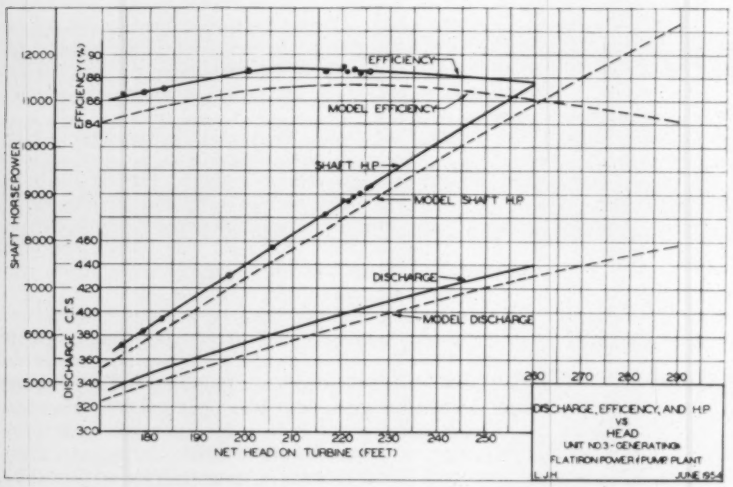



**Fig. 5** Performance curves for generating or turbine operation obtained in tests

justed to unity, and sufficient time was allowed to elapse for the load to become stable. Then the test director gave a ready signal, followed by five reading signals at 1-min intervals. Readings of all instruments and gages were taken simultaneously at these intervals. Five salt-velocity diagrams were taken as rapidly as possible during each run. As soon as the salt diagrams were completed, preparations were made for the next run.

## Test Results

Fig. 4 shows the performance curves for pumping obtained in the tests, with total dynamic head, horsepower input, and efficiency plotted against discharge cfs. The results of the model test are shown by broken lines. The scale ratio of prototype to model was 5.26.

When operating as a pump at 300 rpm and 240 ft total dynamic head, the discharge is 394.5 cfs, the horsepower is 11,793, and the efficiency is 91 per cent. The guaranteed efficiency was 88 per cent, for not less than 370 cfs against 240-ft dynamic head.

The power required at shutoff head, zero cfs with butterfly valve closed, is 8300 hp. The power required for the motor and impeller runner rotating in air with butterfly valve closed is about 360 kw. It is estimated that about 80 hp is required for windage and friction of the impeller runner rotating in air at 300 rpm with the butterfly valve closed.

Fig. 5 shows the performance curves for generating or turbine operation, obtained in the tests with turbine-horsepower output, efficiency, and discharge plotted against net head. The results of the model test are shown in broken lines.

When operating as a turbine at 257 rpm under 250-ft net head, the turbine output is 10,720 hp, the discharge is 431 cfs, and the efficiency is 88 per cent. The guaranteed efficiency was 80 per cent at 250-ft net head with an output not less than 9200 hp. The maximum efficiency of the turbine is 88.8 per cent.

## Performance in Service

The Flatiron pump-turbine is operating very satisfactorily both as a pump and as a turbine. It has now been operating about 21 months. As indicated by the stepup in efficiency for both pump and turbine, it is important that the performance test be made carefully and watched closely for any minor inaccuracy in the observations. Such inaccuracies can become cumulative and cause the final result to be considerably in error. It is believed that the discharge values as measured are well within 1 per cent of their true values, and that the head readings and electrical measurements are within $^1/_4$ per cent of their true values.

The unit can be synchronized very smoothly with the butterfly valve. It was determined by separate synchronizing tests that the unit can be started up from standstill, brought up to 257 rpm, and circuit breaker closed, in 3 to 4 min. With pressure lubrication on the thrust bearing, the combined rotating element of the generator motor and the pump-turbine can be rotated by hand. The total *WR* squared of the generator rotor and turbine runner is about 3,350,000 lb-ft$^2$.

This is the first time that two speeds of operation have been used in the same generator motor coupled to a hydraulic machine to improve the performance of the hydraulic unit. It is believed that this novel idea has proved to be entirely satisfactory, and can be equally successful in other applications.

# Consumable-Insert Technique *for Pipe Welding*

**By R. David Thomas, Jr.**

Arcos Corporation, Philadelphia, Pa.

**This new method of pipe welding employing the inert-gas tungsten-arc torch produces a root pass the internal contour of which is smooth, uniform, and free from objectionable resistance to fluid flow. The technique is most widely applicable to alloy steels, especially stainless steel and the chromium-molybdenum steels, where corrosion or contamination of joints using conventional backing rings poses a serious problem. It is also suitable for a wide range of nonferrous alloys, such as those whose principal element is nickel, copper, titanium, or zirconium.**

In the construction of piping systems for handling radioactive fluids, a completely reliable root-pass welding technique was essential to the success of certain types of atomic reactors. Corrosion attack in crevices or in weld-metal cracks or fissures could cause the shutdown of the equipment, and repairs might not be possible for months or years until the level of radioactivity was sufficiently reduced to permit the exposure of the workmen for even short periods. Piping for atomic installations therefore had to be of the utmost reliability.

Nonconsumable backing rings could not be considered because of crevice corrosion. Furthermore, such rings seriously increased the resistance to fluid flow unless one could use tapered backing rings which were costly.

## Inert-Gas Tungsten-Arc Process Introduced

The advent of the inert-gas tungsten-arc process accelerated the development of root-pass welding techniques which did not require the conventional backing ring. Mueller and Root (1),[1] Pilia (2), and Diehl, Blumberg, and Benz (3) contributed greatly to the development of root-pass welds with smooth internal-weld contours. The authors of the first two papers relied upon careful joint fit-up and merely fused together the pipe ends to form the weld. With certain metals, this technique was satisfactory, but with others, notably Type 347 stainless steel, the complete dependence on the pipe composition to form the weld metal resulted in weld-metal cracking. The well-publicized K-weld technique described in the third paper overcame this problem by adding a filler metal of a carefully controlled composition. All three methods required a skillful operator, a careful control of the internal gas pressure, and close tolerances during fit-up and tacking.

The consumable-insert method of root-pass welding[2] is a natural outgrowth of the methods mentioned, which neatly solves the difficulties just described. By preplacing a filler metal of the proper composition so as to give the desired weld-metal composition, the advantages of the K-weld process are obtained without the disadvantages of requiring a highly skilled operator, internal gas-pressure control, or rigid fit-up tolerances. This process was first described by T. A. Risch and E. A. Dohna (4).

| Nominal Diameter | d | w | h |
|---|---|---|---|
| 3/32" | .156 | .063 | .063 |
| 1/8" | .125 | .047 | .055 |

The 1/8" insert is normally recommended when welding thicknesses of less than 3/32" (.156")

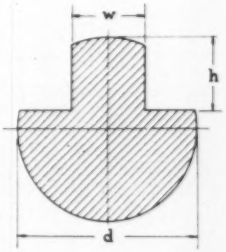



Fig. 1 Table of dimensions and cross section of consumable weld inserts

## The Consumable Weld Insert

The filler metal or insert is obtained by machining, cold-rolling, or cold-drawing the special cross-sectional shape shown in Fig. 1. It is furnished in a wide variety

Contributed by the Petroleum Division and presented at the ASME Petroleum Mechanical Engineering Conference in New Orleans, La., September 25–28, 1955. Condensed from ASME Paper No. 55—Pet-3.

[1] Numbers in parentheses refer to the Bibliography at the end of the paper.

[2] The consumable insert and the consumable-insert method of root-pass welding are subjects of patent claims filed by the Electric Boat Division of General Dynamics Corporation in the U. S. Patent Office and in other countries.

Table 1 Consumable Inserts

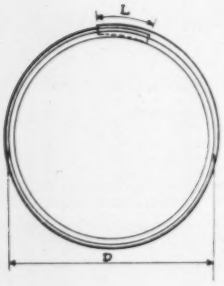
| Type | For welding | Nominal composition C | Mn | Si | Cr | Ni | Mo | Cb |
|---|---|---|---|---|---|---|---|---|
| 131 | Carbon steel | 0.12 | 1.0 | 0.3 | ... | ... | ... | ... |
| 308L | 302, 304, 304L | 0.03 | 2.0 | 0.5 | 20.0 | 10.0 | ... | ... |
| 316L | 316, 316L | 0.03 | 2.0 | 0.5 | 19.0 | 13.0 | 2.2 | ... |
| 347 | 347 | 0.07 | 2.0 | 0.5 | 20.0 | 10.0 | ... | 10 × C |
| 502 | 502 | 0.08 | 0.5 | 0.4 | 5.5 | ... | 0.5 | ... |
| 515 | 1¼% Cr, ½% Mo | 0.08 | 0.5 | 0.4 | 1.3 | ... | 0.5 | ... |
| 521 | 2¼% Cr, 1% Mo | 0.10 | 0.5 | 0.4 | 2.5 | ... | 1.0 | ... |

Fig. 2 Insert material shown in coil form

(*a*) (*b*)

Fig. 3 Rings are furnished either with an overlap as shown in (*a*) or without overlap as shown in (*b*)

Table 2 Consumable-Insert Sizes




| Nominal pipe diam, in. | Ring diam *D*, in. | Overlap *L*, min in. |
|---|---|---|
| 1 | 1 1/16 – 1 3/16 | 1/4 |
| 1 1/4 | 1 5/16 – 1 7/16 | 1/4 |
| 1 1/2 | 1 9/16 – 1 11/16 | 1/4 |
| 2 | 2 – 2 1/8 | 1/4 |
| 2 1/2 | 2 7/16 – 2 9/16 | 1/4 |
| 3 | 3 – 3 1/8 | 3/8 |
| 3 1/2 | 3 1/2 – 3 5/8 | 3/8 |
| 4 | 4 – 4 1/8 | 3/8 |
| 5 | 5 – 5 1/8 | 1/2 |
| 6 | 6 – 6 1/8 | 1/2 |
| 8 | 7 7/8 – 8 1/8 | 5/8 |
| 10 | 9 7/8 – 10 1/8 | 3/4 |
| 12 | 11 7/8 – 12 1/8 | 3/4 |

of compositions, the most common of which appear in Table 1.

For those who wish to form their own rings, the insert material is supplied in coils, as shown in Fig. 2, comprising a continuous length of the desired amount up to 50 ft. Since the rings should be carefully formed with the rib (defined by dimensions *w* and *h*) in the plane of the ring, many users prefer to obtain rings as shown in Fig. 3.

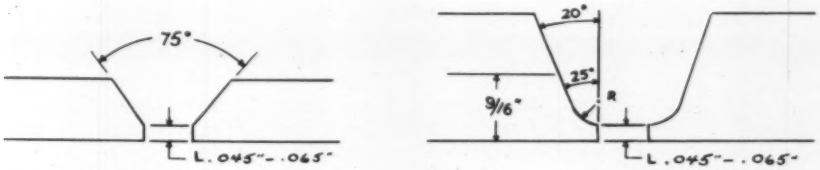
The ring diameters, shown in Table 2, have been standardized so as to fit closely the internal pipe diameter for Schedule 40 standard pipe. The overlap provides adequate insert material to permit the ring to be expanded into thin-wall pipe down to Schedule 5. In most sizes the rings are sufficiently flexible to allow them to be compressed readily into heavy-wall pipe up to Schedule 80 or in the larger sizes up to Schedule 120. When welding very heavy-wall pipes, it is frequently desirable to use the next size smaller ring than the nominal pipe diameter.

Rings are sometimes furnished without overlap as illustrated in Fig. 3(*b*). This imposes a requirement to establish close tolerances so that no trimming is necessary and fit-up costs can be reduced. Such rings are especially useful in repetitive mass-production operations.

## Pipe-Welding Procedure

*Joint Design.* Where highest-quality joints are desired, the pipe ends should be prepared by machining. Flame-beveling and light surface grinding have been found to be a suitable preparation method, however, for many applications.

The recommended joint designs are shown in Fig. 4.




(*a*) Under $^1/_4$-in. wall thickness (*b*) Over $^1/_4$-in. wall thickness

Fig. 4 Preparation of pipe ends

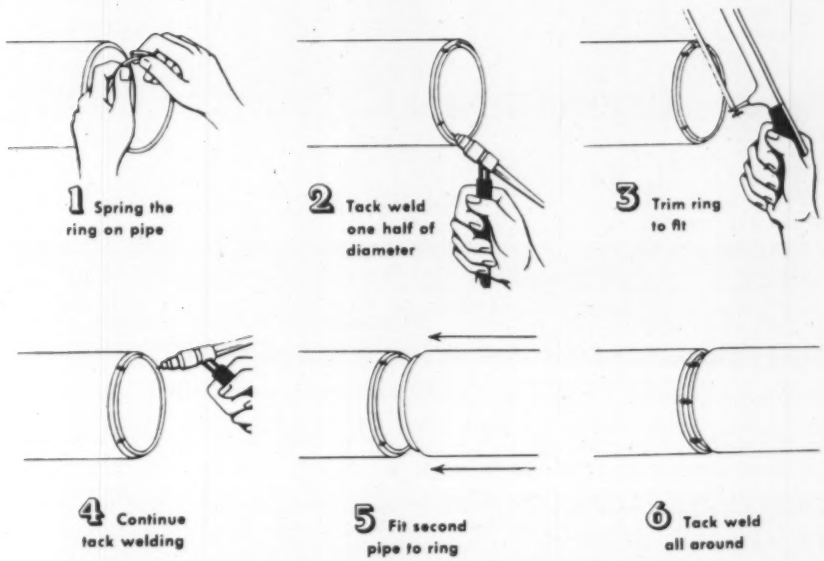

1 Spring the ring on pipe
2 Tack weld one half of diameter
3 Trim ring to fit
4 Continue tack welding
5 Fit second pipe to ring
6 Tack weld all around

Fig. 5 Recommended step-by-step procedure for the fitting-up of a weld insert joint

The root radius $R$, varies from $^1/_8$ to $^1/_4$ in. depending on the metal; the higher value is usually preferred for metals of low conductivity, such as austenitic stainless steel, and the lower value is found to be better for carbon and low alloy steels.

*Joint Assembly and Tacking.* This operation is illustrated by the series of sketches shown in Fig. 5. During fit-up, the gap between the pipe land and the insert, or between the insert flange and the internal pipe surface, should not exceed $^1/_{32}$ in. When trimming the overlap, the gap between the abutting ends also should be less than $^1/_{32}$ in.

*Internal Purging.* To obtain highest-quality welds, purging with an inert gas is recommended. Argon appears to be best for stainless steel and helium for carbon and low-alloy steels. Nitrogen has been found to be a suitable purging gas for many applications; however, it is looked upon with some disfavor when welding steels and other than the austenitic stainless steels because of the fear that brittle nitrides might be formed in the weld pool. On the other hand, in several controlled laboratory tests using nitrogen as a purging gas for carbon-steel welds, we have as yet been unable to detect any evidence of embrittlement attributable to nitrides.

To avoid the necessity of purging the entire piping system, various devices frequently are used to seal the weld area. Metal disks with rubber gaskets connected to a gas hose are commonly employed. Pressure seals are not needed because the insert welding technique does not rely on pressure to form the desired contour. Actually, pressure must be avoided by use of vent holes if tight seals are used.

*Root-Pass Welding.* An inert-gas tungsten-arc torch is used to weld the root pass. The torch gas may be either argon or helium, the former being preferred for the austenitic stainless steels, and the latter for carbon and low-alloy steels. A flow rate of 10 to 30 cu ft per hr normally is used. Because of its greater density argon will require much lower rates than will helium. A $^1/_{16}$-in. thoriated or zirconium-treated tungsten electrode is usually employed. The tip should be ground to a point in order to maintain an arc of high current density. For hand welding, the current will vary between 60 and 90 amp, and the travel rate from 1 to 3 ipm. The inside contour will vary slightly with the choice of current and speed, a high current and a low speed tend to give a flat bead, that is, one with little or no "reinforcement." Fig. 6 shows a cross section of a root-pass weld showing normal reinforcement on the inside.

The flow of metal during welding is illustrated in the two photographs shown in Fig. 7. The movement of the metal from its original location inside the pipe up into the weld groove is explained by a complex interaction of various forces acting on the inside surface.

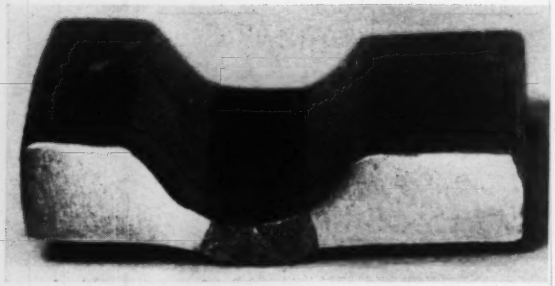
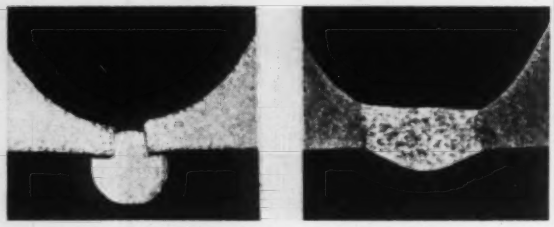


Fig. 6 Typical cross section of a root-pass weld made by the consumable-insert technique



(*a*) (*b*)

Fig. 7 Fusion of the consumable weld insert. (*a*) Insert in place before fusion. (*b*) Root pass after fusion showing extent of flow which has occurred.

At the outset the heat of the arc fuses the top surface of the insert. The heat then flows rapidly downward into the lower area of the insert and somewhat less rapidly into the more massive sections of the pipe ends. The arc maintains a relatively high temperature on the external surface at the moment of fusion of the internal surface. The high surface-tension force existing on the barely molten internal surface as compared with that existing under the arc causes the metal to flow toward the arc. The internal-surface contour is independent of the position of welding, i.e., overhead, horizontal, vertical. Apparently these complex surface forces are enough greater than the force of gravity so that the contour is not noticeably influenced by gravity.

*Operator Training.* Pipe welding always has been looked upon as requiring unusually skillful welders. This is particularly true of those procedures calling for no backing rings. Using the consumable-insert technique, however, a qualified pipe welder will rarely need over one day to develop consistently satisfactory welds, especially if he has been trained in the use of an inert-gas tungsten-arc torch.

*Inspection.* A trained inspector will detect visually any evidence of incomplete fusion of the insert. If this is found, the area can be remelted with the torch and a satisfactory bead contour obtained.

Even though visual inspection methods may ultimately be sufficient, it is recommended that x-ray inspection be employed at the outset for all critical welds. By means of this method, both inspectors and operators learn to detect the surface appearance of incompletely fused areas.

Porosity is occasionally encountered in certain of the low-alloy steels and the porous areas can be eliminated by remelting.

*Finish Welding.* The new technique described in this paper does nothing more than provide a sound and smooth root pass which is generally considered to be the most difficult part of pipe welding.

The completion of the weld can be accomplished by any of the conventional welding processes, the choice depending upon the type of joint, the metal, and other factors.

## Metallurgical Control

The metallurgical control of welding filler metals is a complex subject, and can be covered only casually here as it applies to consumable weld inserts. The reader is referred to the welding literature for a comprehensive study of this subject, especially to the work of A. L. Schaeffler (5, 6).

The composition of the root-pass weld is partly made up by melting the insert and partly by the fusion of a portion of the two adjoining pipes. Fig. 8 shows the microstructure of a stainless-steel weld in which the "dilution" has been estimated to be about 50 per cent. This means that the insert filler metal has been "diluted" by an equal amount of base metal.

In the welding of many metals the preferred composition of the weld metal is frequently found to differ noticeably from that of the metal being welded. For example, in ordinary carbon steels, carbon is usually controlled to much lower levels than in the wrought steel; this is also true with respect to carbon in the chromium-molybdenum steels. Special controls on silicon and manganese levels are sometimes found to be necessary. Chromium in stainless steel is often maintained at a higher level than in wrought steel to give the weld an adequate resistance to corrosion in the as-welded state. Along with certain other elements, chromium also helps to avoid cracks or fissures in the austenitic stainless-steel welds because it provides a microstructure containing small patches of ferrite.

The science of welding metallurgy, which has developed over many years, gives a basis on which to establish the control range for the weld insert. For example, for stainless-steel welding, if a minimum of 19 per cent chromium is desirable in the weld, and if the pipe to be welded is purchased to an 18 per cent minimum chromium, the insert must have 20 per cent minimum chromium to allow for the 50 per cent dilution from the fused pipe metal. These principles have been employed in setting up the standard compositions shown in Table 1.

Machine welding with speeds up to 6 ipm, and perhaps higher, offers a great opportunity to reduce cost. Initial experiments along this line are being carried out as shown in Fig. 9 and appear very promising.

## Advantages

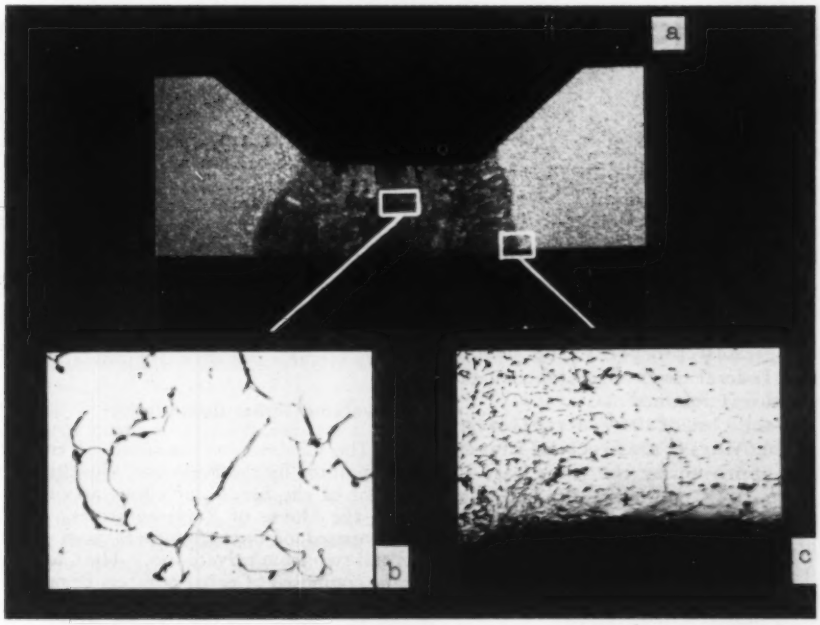
In little more than a year, the consumable-insert technique has been applied widely for root-pass welding of pipe.

Its chief advantages are as follows:

1 The weld-metal composition can be predicted accurately and controlled.

2 Fit-up tolerances are less rigid than other inert-gas welding processes.

3 The internal surface contour is not influenced appreciably by gravity, thus giving similar appearance in all welding positions.




(*a*) ×4 (*b*) ×1000 (*c*) ×100

**Fig. 8 Photomacrograph and photomicrographs of a root-pass weld in stainless steel made by the consumable-insert technique**

4 The internal surface contour does not depend on a control of internal gas pressure.

5 The operator uses a simple one-hand technique requiring little training or experience.

6 Visual inspection for defects usually can be relied upon, though x-ray inspection is recommended during the training of inspectors and operators; when defects are discovered, they can be eliminated simply by remelting that area.

7 The method is adaptable to machine welding.

8 Though somewhat higher in cost than joints with conventional backing rings or those in which little or no attempt is made to control the internal surface of the weld, it is found to be less expensive than methods which produce comparable-quality internal weld contours.

***Acknowledgment.*** The representatives of the Electric Boat Division of General Dynamics Corporation, who developed the technique described in this paper, have generously contributed much of the information and several of the illustrations for this paper. The author gratefully acknowledges the helpful co-operation which he has received on numerous occasions over the past 18 months, during which period the Electric Boat Division and Arcos Corporation have collaborated in making this new process available to industry.

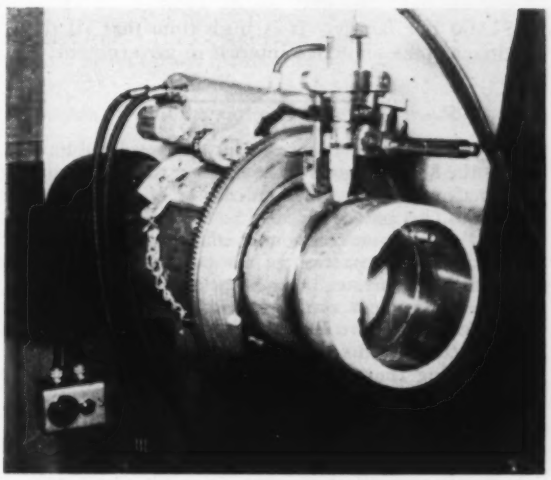


**Fig. 9 Experimental setup for machine welding with consumable inserts**

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# Some Major Findings of the Hoover Commission

By S. C. Hollister, Member of the Hoover Commission

Dean, College of Engineering,
Cornell University, Ithaca, N. Y. Mem. ASME

**The annual cost of the Federal Government, since 1930, has risen from $4 billion to $62 billion. In that time the national debt has grown from $16.5 billion to $270 billion; and although we enjoy our greatest prosperity, the debt is still growing. Federal taxes alone take 20 per cent of the national income.**

**Nearly all of the cost of the Federal Government lies in the activities of the Executive Branch, under budgets approved by the Congress.**

**From 1929 to 1948 public wealth increased 278 per cent while private wealth increased only 78 per cent. In 1929 the public wealth amounted to 15 per cent of the total national wealth. By 1948 it had increased to 27.3 per cent or it nearly doubled in 20 years.**

**In a quarter-century we have witnessed an accumulation of bureaucratic power which is the largest and the most costly that has ever been seen. The current annual cost of the Federal Government amounts to an average of about $1300 per family. It is high time that all the citizens take an active interest in government.**

On July 10, 1953, the President approved Public Law 108 of the 83rd Congress providing for the establishment of the Commission on Organization of the Executive Branch. This law declared to be the policy of the Congress, "to promote economy, efficiency, and improve service in the transaction of the public business in the departments, bureaus, agencies, boards, commissions, offices, independent establishments, and instrumentalities of the Executive Branch of the Government." It charged the Commission with the task of studying and investigating the present organization and methods of operation of all of these units of government except the Judiciary and the Congress of the United States to determine what changes therein are necessary in their opinion to accomplish the policies expressed in the Act by recommending methods and procedures for "(1) Reducing expenditures to the lowest amount consistent with the efficient performance of essential services, activities, and functions; (2) eliminating duplication and overlapping of services, activities, and functions; (3) consolidating services, activities, and functions of a similar nature; (4) abolishing services, activities, and functions not necessary to the efficient conduct of government; (5) eliminating non-essential services, activities, and functions which are competitive with private enterprise; (6) defining responsibilities of officials; and (7) relocating agencies now directly responsible to the President in departments or other agencies." The Commission was directed to report not later than May 31, 1955, accounting for its activities and making recommendations for such constitutional amendments, legislative enactments, and administrative actions as in its judgment are necessary to carry out its recommendations.

Address delivered at Luncheon during the Engineers Joint Council General Assembly, New York, N. Y., Jan. 26–27, 1956.

### Twelve-Member Commission

The Commission consisted of twelve members, four appointed by the President, four appointed by the President of the Senate, and four appointed by the Speaker of the House of Representatives. Each group of four consisted of two appointees from government agencies and two from private life. The Commission was also to be composed of equal numbers of members from the two major political parties.

The Commission held its organization meeting on September 29, 1953. It made its final report on June 30, 1955, which date was authorized by the Congress through subsequent legislative enactment. On that date the Commission ceased to exist.

During the years 1947 to 1949 a similar Commission had served and had made a series of reports. It is popularly known as the First Hoover Commission. Its range of activity was confined chiefly to the organizational structure of the Executive Branch, on which it made 273 recommendations of which three fourths have been adopted with a saving of several billion dollars.

The Second Commission, however, was charged with the responsibility not only of looking at the structural organization but the function and policies of the several agencies as well. As a result this was the most searching examination of the Federal Government made since the Constitutional Convention of 1787.

Sixty of the 64 executive agencies were studied. These agencies account for over 95 per cent of the expenditures of the Executive Branch. The Commission submitted 20 reports to the Congress comprising about 1700 pages, and supported by the reports of its Task Forces comprising several million words. These reports are available from Superintendent of Documents, Washington, D. C.

The Commission made in all 314 recommendations. However, only certain major findings and a few examples of interest to the engineering profession will be cited.

The enormous expansion that has taken place in the Executive Branch during the last 25 years has resulted in producing the most fabulous operation on earth. There appears no present indication that the agencies are trying to level off in size. On the contrary, there is every indication that many of them are trying to continue the prodigious expansion of recent years. After the first World War there was a shrinking in the size of government. After the second World War, however, there appears to have been no such shrinkage. Even though we are more prosperous than ever before, our national

debt is still rising. We have even grown a new crop of economists, so-called, who try to tell us that our public debt is simply a borrowing from ourselves and that it is not an unhealthy situation to continue deficit financing.

The sheer bigness of the operation of the Executive Branch, as one may expect, has resulted in inadequate accounting, lack of inventory, widespread confusion, hidden subsidies, conflict of objective, and the attendant duplication and waste.

**Poor Inventory Situation**

To get some notion of bigness and its effect upon the problem of control some of the inventory situation may be cited. The Federal Government owns one quarter of the land area of the continental United States. There is no currently maintained land inventory. The result is that new acquisitions of land are being made without realizing that nearby is government-held property that would suffice.

The Federal Government's depot system comprises about 50 square miles of space, the portion which is under cover amounting to more than the area of Manhattan Island. Not only was it found that there was not an adequate inventory of this storage space but 100 million square feet, or over 2000 acres, of floor space was not even listed on operating records.

It was further found that there was not an adequate inventory of common-use goods, comprising items which are used alike by civilian agencies and the Department of Defense, as well as by the civilian economy as a whole. It took the Department of Defense 8 weeks, and 8 civilian agencies from 3 to 11 weeks, to find out whether they had 12 items of common-use goods in hand.

The rapid increase in size has simply outrun the installation of adequate efficient systems of records by which controls may be maintained over the whole enterprise.

There is a tendency of the individual agencies to hoard their holdings and to make their operations self-sufficient. The Commission believed that with an adequate inventory, land owned by the United States would be available for assignment to an agency having use for it, and reduce the acquisition of more land. The Commission also made recommendations concerning the setting up of criteria for declaring real property excess or surplus, and for machinery for disposing of the surplus. It was urged that the Federal Government divest itself of surplus real property as rapidly as possible.

The same situation holds for property other than real estate. As an example cited by the Task Force on Surplus Property, the Navy decided in 1949 to reclaim pig lead from scrap metals on hand and over the next four years accumulated 18,000 tons of pig lead, worth about $5.3 million. This lead was not offered for possible use by other agencies, and was even retained during a period of maximum shortage of lead in the national economy. Had it been diverted to the economy it would have been reallocated by the National Production Authority, and the Navy would have received its fair share in case it had need for it. At the same time the General Services Administration was accumulating a national stock pile. The Navy would not transfer it to GSA for nothing and GSA would not pay the Navy anything for it, so it did not get into the stock pile. Army Ordnance was in need of lead wire and lead in other forms requiring an addition of antimony. It rejected the Navy lead to which the antimony could have been added and instead went into the open market and bought 5000 tons of lead wire and other things for $1.5 million, although a general shortage of lead existed.

The Commission believed that great savings would result from better inventories, better procedures for screening excess and surplus property, and a different system of budget structure. By improved methods of disposal of surplus it is estimated that for the first four years about $2 billion a year could be recovered by the Treasury, and thereafter an annual recovery of about $1 billion.

Another example of the bigness of the Federal Government is the amount of working space it owns. The Executive Branch has lands and improvements for such use amounting to $40.8 billion in original cost. This does not include the industrial reserve amounting to $3.8 billion, nor does it include the public domain. It does not reflect the replacement cost at current market value, which is very much greater. For example, the Presidio at San Francisco consists of 1437 acres of original Spanish grant public lands acquired at no cost, and 5 acres purchased subsequently for $98,995 and that is the figure given on the records for the entire 1442 acres. San Francisco officials state the land alone is worth about $50 million for development purposes. In a similar way Governors Island in New York Harbor, consisting of 205 acres of land received by the Federal Government in a series of grants from the State of New York, is carried on the government records at $1. Only the improvements made subsequently are shown on the record, in addition to that sum. As stated earlier there is no complete inventory of such property held by the Federal Government in records of the type used in modern real property management. The Commission recommended that such a record be set up and maintained on a current basis.

**Operation of Commercial and Industrial Facilities**

One of the most impressive findings was the extent to which the Federal Government is operating commercial and industrial facilities. It is impossible to make an accurate estimate of the extent of such operation but it is believed that they total over 3000, and that in the Department of Defense alone there are over 2500 such facilities in which government capital invested probably exceeds $15 billion. In general these facilities are operating in competition with privately owned commerical concerns. These concerns pay taxes which the Government then uses to compete against them.

As an example of conflict of function, in fiscal 1954 the Government operated a fleet of 221 ships for transport carrying freight and passengers. These ships often operated on lines paralleling those of commercial shipping companies which received Government subsidies in order to maintain an American Merchant Marine. In the same way, the Federal Government operated air-transport service costing nearly a half-billion dollars annually and flying routes paralleling commercial lines to which the Government pays subsidy in order to build up our air-transport system.

Another example to show the competition of interests between different parts of the Government is the fact that in these times when we have enormous agricultural surpluses, purchased and stored by the Federal Government in order to sustain agricultural prices, other parts of the Government are asking for appropriations with

which to extend agricultural output through the extension of irrigation. They propose doing this at the fantastic cost to the taxpayer of nearly $2000 per acre.

In the whole area of government-operated business enterprises the Commission found repeated claims of lower cost through government operation. Again and again, however, the Task Forces looking into these matters found that underlying the so-called low cost of goods and services was an inadequate accounting system that did not include all the costs of providing the goods and services. Take the Military Sea Transport Service, for example, which operated 221 ships in 1954, carried over 2 million passengers, and about 3 million tons of cargo including petroleum products. The operating costs were stated to be $549 million for the year. The Task Force, however, points out that these estimated costs did not include military pay and retirement allowances of certain personnel involved, nor depreciation, interest on investment, taxes, and other items, which it is calculated would add at least 20 per cent to the total.

The Department of Defense operates 438 commissary stores with total sales in fiscal 1954 of over $300 million. Of these 199 are in the United States with sales of $185 million, employing 7411 people of whom 4804 were military personnel. The Congress has expressed concern again and again in recent years over the possible competition of these commissaries with private enterprise in many metropolitan localities. They provided that no appropriation would be spent for the operation of commissaries in the United States unless the Secretary of Defense certified that satisfactory items normally procured from such stores were not otherwise available within a reasonable distance and at a fair price. The Department of Defense established the base of fair price by stating that the commissaries would continue where the average total price of all items included in the family market basket, as sold by the private stores, exceeds by 20 per cent the average total cost of the same items to the commissary. Under this rule the operation continues without restriction in many large cities where there is ample private service.

The crux of the situation lies in the accounting methods. To allow for building repairs and some of the cost of handling, pilferage, and spoilage, goods sold by the commissaries are marked up between $3\frac{1}{2}$ and 5 per cent of the cost. To cover the cost of military personnel employed in commissaries, depreciation, interest, and other operating expenses, the charges on supplies would need a mark-up of about 10 to 14 per cent, not including tax exemption, and in such calculation taxes otherwise collectable from private enterprise should be considered. The Commission comments that the whole operation is at least a vivid illustration of how bureaucracy can expand against the intent of the Congress accompanied by a failure to include real costs. The real justification, the Commission states, of the continued operation of most of these stores is a "fringe benefit" to the military personnel and their families. The question arises as to whether such subsidized facilities should be continued in competition with private enterprise, or whether increased salary payments to government military-service employees would not be more consonant with sustaining our economic system.

Among other things the Department of Defense operates 46 commercial-type bakeries, 5 coffee-roasting plants, 71 meat-cutting plants, 2 clothing-manufacturing plants, an officers' custom-tailor shop, and 360 laundries and dry-cleaning plants. It maintains 381 facilities in the United States for manufacture and repair of medical and dental supplies. The Commission recommends that except when located in isolated or overseas areas, all of these facilities be closed.

Competition of this type between Government agencies and private enterprise is made increasingly unfair because of the increased income taxes now being imposed on corporation and private individuals. Such operations have been increasing both in size and number. In effect, the Government is busy actively promoting the killing of the geese that lay the golden eggs.

### Executive Branch Management—A Major Problem

A major problem created by the sheer size of the Executive Branch is its over-all management. It has already been stated that there are 64 executive agencies all of which report to the President. It is physically impossible for him to manage these agencies, and yet it is apparent that closer management is essential if what goes on in these individual departments and bureaus is to be controlled. The President has direct responsibility for 31 of them. The remaining 33, however, could, in the Commission's opinion, be placed under the direction of an executive designated by the President who would manage them in the President's name. This would help considerably toward lightening the President's load.

Another area in which a considerable amount of aid to the President should be given is that of budgeting and accounting. The Commission considers it important to strengthen the management functions of the Bureau of the Budget. Its responsibilities for the preparation of the Budget have subordinated its over-all management and policy function. Emphasis has been placed too much on budget mechanics. The Commission noted that for the fiscal year 1954 the cost of operating the Bureau was only 1/200th of one per cent of the entire budget, and believed that in view of the potential saving in a budget exceeding $60 billion some increase in the resources of the Bureau would seem justified.

The Commission proposed also that the present method of budgeting in terms of obligational authority be replaced by a budget based on annual accrued expenditures representing charges for the cost of goods and services estimated to be received. Under such a form of budget, government accounts would be kept on an accrual basis to "show currently, completely, and clearly all resources and liabilities and the cost of operations."

The Task Force on Budgeting and Accounting stated that under present procedures "there is no effective control for expenditures either by the Congress or the Executive Branch." Under present procedures of budgeting and appropriating for obligational authority, there are huge unexpended appropriations carried forward from year to year, running as high as $78 billion for fiscal 1954, $68 billion for fiscal 1955, and an estimated $54 billion for 1956. It is believed that the reform in budget procedure would make possible better financial management. The Task Force believed that a possible $4 billion a year could be saved thereby.

The Commission points out that Congress enacts legislation for undertakings which leave the appropriations committees little discretion as to the amount to be appropriated, with the result that control through the budgetary process over the total size of the budget is impossible. The Bureau of the Budget states that the

net expenditures for the fiscal year 1955 of $15.3 billion or 24 per cent of the total budget are relatively uncontrollable under present law. This sum includes $6.6 billion for interest on the public debt, $3.5 billion for veterans' compensations, pensions, and benefit programs, $2.2 billion for agricultural price support, $1.4 billion for grants to states for public assistance, and $600 million for Federal highway grants. The Commission recommends that legislation committing the Government to continued expenditure for special programs which are not susceptible to the usual budgetary control, ordinarily be enacted for a limited term to require periodic Congressional review of their usefulness. Such re-evaluation would enhance budgetary and Congressional control over the expenditure of such large and continuing sums.

**Federal Medical Care**

The Federal Government has undertaken specific responsibilities for all or part of the medical care of about 30 million of our people at an annual cost of over $4 billion. Ninety per cent of this service is in the Veterans Administration, Department of Defense, and Department of Health, Education and Welfare.

Of this 30 million, 4 million, mostly on active military duty, and $3^1/_2$ million veterans with service-connected disabilities, are entitled to complete medical care.

About 20 million people are eligible for care on a facilities-available basis. Of this number, $17^1/_2$ million are veterans with no service-connected disabilities who are eligible for free hospitalization on their statement of inability to pay. About 2.9 million are dependents of military personnel. Retired military personnel make up most of the balance of the 30 million.

There are about $2^1/_2$ million Federal employees eligible for limited on-the-job health services for occupational injuries and disease.

There are 26 Federal departments or agencies engaged in one or more of these health functions.

Currently the Federal Government employs about 10 per cent of all active physicians, 9 per cent of all active dentists, and 6 per cent of active graduate nurses. The Federal hospitalization amounts to 7.3 per cent of all hospital admissions.

The Commission was very emphatic in its endorsement of full medical services to disabled veterans. It expressed concern however over the lack of cross-servicing in military hospitals and the fact that although over 60 per cent of the beds in the Department of Defense were unused in 1955, over $60 million were being spent for new construction of hospitals. Also, in the Veterans Administration, with about 25 per cent of the beds in general hospitals unused, the Administration is carrying on further construction.

The veteran's statement of his inability to pay his hospitalization not arising from service disability is not under the law subject to verification by the Veterans Administration. An investigation by the Medical Task Force of 336 declarations of veterans with annual incomes of $4000 or more, shows that one had an income of $50,000; 25 had assets of $20,000 or more; and 4 had assets between $100,000 and $500,000. The Commission recommended that all such statements of inability to pay should be subject to verification by the Veterans Administration.

The Commission further recommended that a veteran should assume a liability to pay for care of his non-service-connected disability. If one looks ahead, with the constantly rising number of veterans, one can see that the net effect of the Federal Government's present obligation to render medical service is to furnish in fact a system of socialized medicine. In 1954 60 per cent of the 109,000 beds in the VA occupied on an average day were occupied non-service-connected cases. In 1953 in military hospitals 70 per cent of the beds were occupied by dependents of military personnel and during that year 145,000 babies were born in military hospitals.

Recently in the press it was reported that the Veterans Administration is unwilling to adopt the major recommendations of the Commission relating to it. No bureau wants its operations curtailed.

Not mentioned has been the seriously disturbing outlook in Federal participation in water resources and power. It also has not been mentioned that in the midst of lavish Government spending there is almost insignificant support given to basic research. Both of these subjects are being dealt with more at length by the distinguished Chairmen of the Task Forces on Water Resources and Power, and on Research and Development, Admiral Moreell and Dr. Kelly.

The Commission dealt at some length with the problems of manpower especially in the area of management. It supported its Task Force recommendation that there be set up a Senior Civil Service consisting of politically neutral career administrators of special skill and experience for continuing service in all departments and agencies. By this means it was hoped that a strengthening of the management function could be achieved on a non-political basis.

The Commission also made extensive recommendations concerning improvement in the personnel practices.

**Commission Recommendations Can Save Dollars**

Summing up the benefits to be achieved through the adoption of the recommendations of the Commission, estimates have been made to indicate a saving of something like $6 billion annually with perhaps $10 billion of recaptured invested capital that could be returned to the Treasury. At any rate it can be stated confidently that the savings would be sufficient to balance the budget and to permit a reduction in Federal taxes or reduction of the national debt. But this is only the dollar side of the benefits achieved. More importantly, there would be improved controls of continuing benefit in the achievement of a better-managed Federal Government. There would also be a considerable reversal in the bureaucratic tendencies to grow bigger and bigger, as they are now doing in the absence of effective checks and balances.

But money and efficient management are not all, or even the most important part, of the story. Our government is the living, continuing entity that, within our Constitution, should preserve for us, the citizens, our way of life. The Government, whether intentionally or not, has embarked on business enterprises, on the nationalization of power, on socialized medicine. Is this the way the people want to go? The reports of the Commission present these problems and suggest cures.

None of the improvements recommended by the Commission will come about if the citizens of the country sit complacently on the side lines. We have the biggest and most expensive Government in the world. We are on trial to see whether we can make it effective without its becoming our master.

# A Role for Student Professional and Honorary Societies in Engineering Education

By Robert C. Dean, Jr.[1]

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TODAY we are witnessing, in engineering thinking and education, a revolution which is permeating industry and the technical schools. The underlying causes of our changing attitudes are not difficult to find; undoubtedly the pressure of scientific discovery during the past twenty years has fertilized the reawakening of engineering thought. At the end of the past century the construction of our industrial foundation invigorated the engineering profession; now the vast accumulation of scientific knowledge presents such undeniable opportunities for engineering application that no industry, no engineer, can afford to ignore the challenge. However, to understand, to interpret, and to utilize this ever more complicated array of knowledge, both the engineer's skill in illuminating his path by use of what we call "the fundamentals," and his ability to synthesize and solve by abstract thought processes, must be increasingly refined. To keep abreast of the breath-taking progress, he must engage in vigorous self-education throughout the span of his career. In addition, with the growing, and today almost decisive, impact of technology on our society the engineer stands in a position of special responsibility. He must guide our technical progress toward the greatest benefits for the whole community.

### Future Engineers to Face Broad Problems

The engineer of the future, with significant responsibility, will bend his efforts more and more toward problems which are broad in nature. The specialist will not fill the positions of leadership, because optimum solutions of engineering problems will increasingly span all of the traditional disciplines, mechanics, materials, thermodynamics, electricity, atomic physics, economics, and human relations. Today we see increasing trends, in our more progressive industries, toward such engineering.

Engineering educators must measure as best they can the course of the future, for they train men not for today, but for major responsibilities 20 or 25 years from now. Many educators and industrial leaders have come to believe that a vocational training for the tasks of today must be replaced by a broad, fundamental education in science. But, to produce engineers, not scientists, increased attention in the education must be given to the uses of fundamental knowledge and to development of the attitudes most likely to lead to progress. We must strive to develop ever more highly in the graduate the pioneering spirit, the nonconformist thinking, the ability to synthesize complicated technical, economic, and human problems, and the constructive drive, all of which have characterized the engineer from the beginning. To these, we must add the humanities as basic studies and interests in a preparation for leadership in our society. Motivation through the study of the past and present art will wane due to a lack of time. Instead, pleasure in understanding as well as producing successful machines must motivate student and practicing engineer alike.

To accomplish this pattern of education requires more than a resolution on the part of a faculty. It demands a great deal more from the student than we have asked in the recent past. A man has never been mentally developed or matured by others; he is only inspired and guided in that struggle which he alone must win with his human desires for an easy life. The tone and accomplishments of an educational institution, and for that matter, of any human endeavor, are set and realized not by policy but by the men and women engaged therein.

When I was in college, there seemed to be a great apathy and disinterest among many students, including me. The excitement and challenge of a career of expression through engineering had evaporated. To produce the engineer of the future that I have described, we must recapture in the schools and in the profession the excitement and sense of high adventure which reward those who strive to improve the world.

### Student Leaders and Student Groups

Here we come upon the role of student leaders and student groups. In engineering schools, the student professional and honorary societies are often the only, and usually the best, means for student expression and action. I believe the role of these groups is clearly defined. It may be said that "this philosophizing is all very well, but we have tried what you suggest and often have gained no results." I would sympathize with this except that I have seen student leaders arise and through the ASME and Pi Tau Sigma activities at M.I.T. inspire both students and faculty alike. I now offer some of this experience with the hope that this success may be repeated and amplified throughout our technical schools.

When I was a sophomore, I decided that it would be proper to join the ASME. I did and promptly noted that a meeting was scheduled for the coming week during which, in addition to an instructional movie on the production of a cast-iron soil pipe, there would be an election to fill the important Society offices for the next year. In the dark of the movie I did not sense the hot eager enthusiasm which should greet such a subject, but it was not until the lights sprang up that I realized

[1] Recipient, Pi Tau Sigma Gold Medal Award.

Address delivered at the Members and Students Luncheon during the Diamond Jubilee Annual Meeting, Chicago, Ill., Nov. 13–18, 1955, of the AMERICAN SOCIETY OF MECHANICAL ENGINEERS.

that the hot enthusiasm was a bit diffuse since only four of us sat in a room fitted for four hundred. Now came the long-awaited election. Nominations—"that sleepy new fellow up there for secretary." Yes, they meant me; it took some persuasion but I escaped and the ASME had no secretary for awhile.

I was much impressed and surprised when I became reacquainted involuntarily with the ASME Student Branch three years ago upon being elected Faculty Adviser. I, incidentally, had to join the ASME in order to accept this position. For many reasons I am glad that I did, the two most important being that I have had the good fortune of working with those students and the opportunity of addressing you today.

The ASME group was slowly gaining strength at the time; Pi Tau Sigma was almost defunct. Today both groups are strong and definitely leaders in student action at M.I.T. It was not my influence that initiated this reawakening but, I think, a rather sudden realization among some of our students that they could and should take the lead in increasing significantly the benefits to be reaped from four years of college by helping to establish a tone of serious, but adventurous and enjoyable scholarship. It is important that their only goal was to be of service to the educational community.

### Student-Faculty Relations

Everyone agrees that student-faculty relations should be mutually respectful, vigorous, and enjoyable. This problem has been tackled in many ways at M.I.T. by students and faculty. Student enthusiasm and assistance were crucial to the creation of a Common Room in the mechanical-engineering department. This is no ordinary room in design and use. The ASME, Pi Tau Sigma, and others are insuring that the ultimate goal of a free exchange of ideas is fostered therein. For example, it has become a lunchroom in which vigorous discussion blossoms each noon between the students and the "sandwich-packing" faculty. It is jammed every month or so for Student-Faculty dinners, arranged by the ASME, at which are debated openly such controversial subjects as, "Do we need marks?"; "How does mechanical engineering at M.I.T. stack up?"; "Should homework be required?"; "Are there too many student projects in the curriculum?" and so forth. These meetings, in my opinion, are one of the most effective means of building an espirit de corps in the educational community.

We all feel that every student should produce some piece of truly creative work in college, an experience which is calculated to enamor him with the satisfaction derived from original work. It is often difficult to encourage a student to assume the faith required in overcoming the difficult initial stages of any worthwhile endeavor. Unless a man previously has tried hard and succeeded in a challenging task, he requires great motivation to plunge in and take the risks. Here the ASME branch and Pi Tau Sigma have made a real contribution by encouraging and popularizing the preparation of student papers for the ASME Regional contest. Last year our preliminary contest was a high point of the mechanical-engineering student's year, with seventeen papers read and four significant prizes awarded. The first prize was a new award conceived by the ASME branch and called the C. Richard Soderberg prize. The winner of this prize carried his group's success to its climax by winning the first prize of the regional contest.

ASME student committees and individuals have largely run the annual Mechanical-Engineering Open House for Freshmen. On this day they attempt to communicate their enthusiasm to potential mechanical engineers.

A monthly ASME newsletter, established last year, strives to give a sense of group identity to students enrolled in the department. It has kept the students aware of department activities and sought to enlighten them about faculty and facilities by feature articles.

Pi Tau Sigma has reactivated a service of value to students and faculty alike. This is a rating system on courses and teachers which insures that every teacher and every course will be exposed to honest and constructive student criticism. I can assure you that results of this rating are awaited with great interest and respect by the faculty.

For their leadership in establishing an esprit de corps among mechanical-engineering students and for their service to the community, Pi Tau Sigma and ASME were awarded one of the Karl Taylor Compton prizes which were established to foster and recognize in the M.I.T. community those qualities of character—selflessness, service, humility, tolerance, instinct for the good and true, strength of purpose, courage, and faith—which the life of Dr. Compton so clearly exemplified. With the prize came an award of $500 which is now plowed back into the continuing program of service.

### Conferences and Meetings

This year the two groups have conceived, initiated, and are administering a promising conference on professionalism. This conference spans the School of Engineering, including the President of M.I.T., the Deans, the Department heads, faculty, and students. During two days of meetings, this group of about forty will strive to discover better methods of inspiring zeal for an education toward productive engineering careers.

Pi Tau Sigma is attacking the problem of the "dark year," the sophomore year, during which so many students plod their round of classes without raising their eyes and minds to the opportunities and adventure about them. During this time the shock of the freshman year has not been soothed by the awakening interests of the upper years. However, Pi Tau Sigma hopes to hasten the conversion with increased contact between sophomores and upper classmen and with a booklet on the department, curriculum, faculty, and facilities.

Each year the technical meetings of the Student Branch have aimed at a higher plane, at talks which demonstrate the best thinking on technical, business, and human problems. Renowned men from industry and our own faculty are featured. Students have tried to avoid the generalized lecture as "Why join the ASME after graduation?" preferring to teach this lesson by example.

The activities of these two groups have produced an improvement in student morale which is measurable in the classroom. A few less glassy eyes survey the antics of the teacher. While there is a growing tension in the air of student thought, ideals, and enthusiasm, much remains to be done. Even at M.I.T., one third or so of all students are passive; these need awakening. The faculty and administration need constant pressure and encouragement from the students.

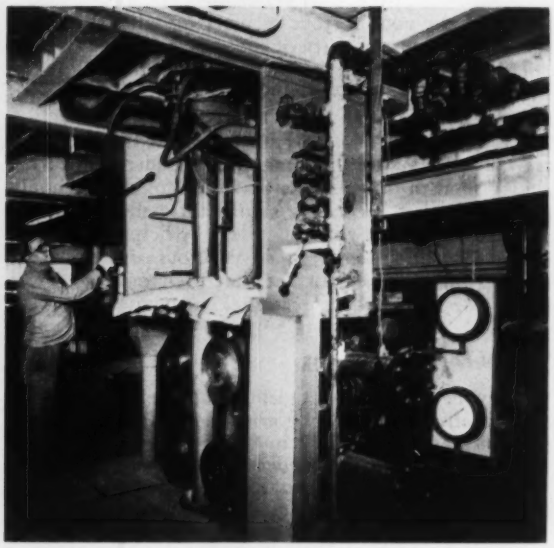
Therefore, to all student leaders and faculty advisers, I recommend these tasks of leadership and service as the role for your Student Professional and Honorary Societies.

# Briefing the Record

## Abstracts and Comments Based on Current Periodicals and Events

J. J. Jaklitsch, Jr., *Associate Editor*

View of melting and holding furnaces for Asarco's new 5 to 9-in. continuous-casting unit. Pure copper and various alloying metals are melted in a rotary Detroit electric-arc furnace (*right*) to produce an alloy of controlled composition. Molten bronze is poured from this unit into the electrically heated holding furnace, or crucible, in front of it (*left*).



From the crucible, the metal enters the graphite die, under gravity feed. Electric roll drive, mounted directly beneath, controls speed of casting. Shown above, a 9-in. bronze tube is quickly solidified in graphite dies encased in high-capacity water jackets (*top* of photo). Casting furnace is on the floor above while the cutoff saws are located on floor below.

### Continuous Casting

METALLURGICALLY superior continuous-cast bearing bronze is now available in 44 new, larger sizes from 5 in. to 9 in. in diam, in many foundry alloys and a variety of shapes up to 12 ft long, according to the Continuous-Cast Products Department, American Smelting and Refining Company, Barber, N. J. Up to now, bronze produced by the patented Asarco process ranged from $1/2$ in. to 5 in. in diam.

Recently, size and capacity of centrifugal and hydraulic pumps, stamping and forming presses, and a great variety of machine tools and other equipment, using bronze bearings, gears, and other parts, have increased in great strides. It became apparent several years ago that Asarco's continuous-casting process must be enlarged to keep pace with this growth. Other industries which are expected to benefit by the availability of this superior bronze in large diameters are steel, pulp and paper, shipbuilding and repair, construction materials and construction equipment.

The announcement of 5 to 9-in-diam Asarcon 773 bearing bronze is the result of several years of intense effort by this company to break through into the larger sizes. The nature of the vertical casting units producing the bronze imposed severe engineering problems. The break-through was eventually accomplished as a result of certain design modifications in melting, casting, driving, sawing, and handling equipment.

The basic process remains unchanged. Molten metal, supplied by an auxiliary melting furnace, is maintained at a proper temperature in the casting crucible. Solidification of the rod or tube takes place in a self-lubricating water-cooled graphite die. Driving wheels, mounted directly beneath, withdraw the solidified product continuously at controlled speed. A traveling saw, mounted below the driving rolls, is engaged at proper intervals to cut uniform lengths. (See MECHANICAL ENGINEERING, June, 1953, pp. 488–489.)

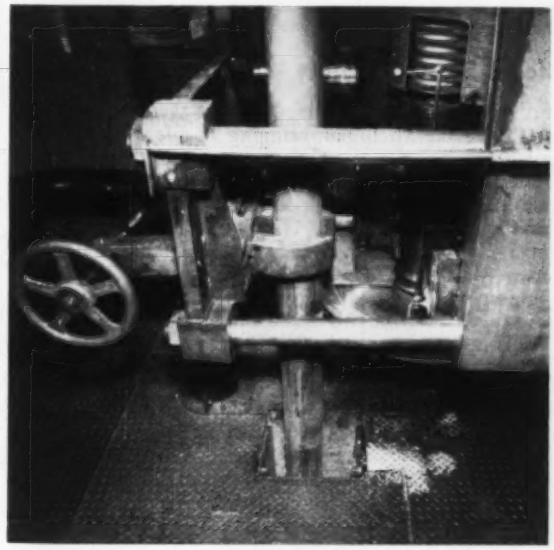
The copper-base alloy stock produced by this process in a form equivalent to mill-length rods, tubes, and shapes is ready for machining or other fabricating operations.

Because the process operates as a true gravity-feed bottom-flow casting method, it precludes the possibility of trapping incidental dirt and dross. What foreign matter does enter the system floats on top of the melt and is not carried into the product. Freezing from the bot-

tom upward permits the escape of any dissolved gases which are liberated during solidification; thus there are no blow holes, no porosity, or hard or soft spots.

No sand is used in the casting process; therefore the metal is completely free of sand. Tools last longer; work goes faster; and there are no rejects because of metal quality. Asarco's continuous-cast products feed perfectly through automatic screw machines.

One advantage of the continuous-cast process is that a customer can get a product cut precisely to his own particular requirements in lengths. This enables him to buy and handle fewer pounds of metal, cuts cost by cutting waste. There are no remnants as in the case of conventional 12-in. or 13-in. lengths. Moreover, casting tolerances are so close that the finish cut wastes a minimum of metal and a minimum of machine time.



**After leaving the roll drive, the casting enters the saw floor where a cut-off saw mounted below the driving rolls is engaged at proper intervals, traveling down with the casting, sawing as it goes, cutting the stock to order length, usually 105 in. or 12 ft, and up to 16 ft on special arrangements. When a length is sliced off, the saw returns automatically to it upper position ready to start again.**

## Future Heavy-Press Considerations

With the four forging presses and all the extrusion presses, with one or two exceptions, of the USAF Heavy Press Program now in operation, Alexander Zeitlin appropriately reviewed the current problems in plastic forming of metals and attempted to indicate the developments to be expected in the next 10 years, during the 1955 ASME Diamond Jubilee Annual Meeting held in Chicago, Ill. Mr. Zeitlin, a member of ASME, is the vice-president of Birdsboro Steel Foundry & Machine Company, Birdsboro, Pa.

Of interest was the list of projects which Mr. Zeitlin felt would speed the Heavy Press Program's advance into the unknown and aid the Program in proceeding in the desired direction. He subdivided his suggestions into recommendations for research and development work as well as recommendations for some new facilities.

Mr. Zeitlin's suggestions for research and development projects included the following:

1 Continuation of the development of large circular billets for extrusion presses as conducted by Kaiser Aluminum & Chemical Corporation for the past four years. The first objective should be the casting of 75 S billets up to 35 in. in diam on a production basis.

2 Continuation of the development of large ingots for rolling mills as conducted by ALCOA, Reynolds, and Kaiser, over the period of the past few years. The first objective should be the casting of a 25,000-lb ingot of 75 S alloy, 60 in. wide, 20 in. thick, and at least 15 to 18 ft long.

3 Continuation of various efforts for the development of new methods for producing flat and coiled stock with by-passing the ingot stage.

4 Continuation of the development of the know-how in extruding rectangular billets.

5 Continued research on extrusion of titanium, making sure that an exchange of information is established not only among all companies engaged in projects financed by the government, but also between these companies and the rest of the industry. Thus far there has not been any joint compilation and evaluation of results.

6 Continued research on lubrication of titanium and steel extrusions.

Mr. Zeitlin's suggestions with reference to machinery were as follows:

7 A study preliminary to planning and installation of a 100,000-ton closed-die forging press, either by expanding one of the existing facilities, or by reinstating and modifying one of the partly finished facilities, such as the Newark facility of Kaiser.

8 Study advanced designs of extrusion presses of 20,000-ton capacity and, depending on the result of the study, the construction and installation of a modern up-to-date 20,000-ton press.

9 Advance the operational know-how and machine design for the secondary operations in extrusion and rolling-mill plants; among others: (*a*) Stretcher-straightening operation on machines with a capacity of at least 20,000 tons for plates 6 in. thick and 144 in. wide; and (*b*) roller straightener for plates of at least 144 in. wide and 6 in. thick.

10 Sponsor the development, engineering, and installation of specialized machinery such as a multiple-operation press in which elements of landing gears can be produced to practically finished shape in one setup, or a specialized extrusion press of a design which would facilitate upsetting and piercing operations.

11 Make sure that the installations referred to in items 7, 8, 9, and 10 will be equipped to handle steel and titanium. This is particularly important for the 100,000-ton forging and 20,000-ton extrusion presses. (In Mr. Zeitlin's opinion, they should be installed in facilities open to all metals—aluminum, magnesium, steel, titanium.)

12 Sponsor and support research on controlling the die and tool temperature by heating and cooling. Such research to apply to extrusion and forging dies.

13 Sponsor the organization of an industry advisory committee on plastic forming of metals, consisting of

representatives of the government agencies, users (such as air-frame manufacturers and machine builders), for the purpose of co-ordinating all research activities, and the planning of new industrial facilities.

## 2200-Lb Vacuum-Melting Furnace

THE first heat of the nation's largest vacuum-melting furnace was tapped recently by Vacuum Metals Corporation at Syracuse, N. Y. Jointly owned by Crucible Steel Company of America and National Research Corporation, Vacuum Metals was the first commercial producer and the first fully integrated producer of vacuum-melted metals and alloys in the country.

Dwarfing the earlier 300 and 600-lb furnaces, the new 2200-lb vacuum-melting furnace is a far cry from the small crucibles that produced the first samples of vacuum-melted metals in the laboratories of National Research Corporation more than ten years ago. This new furnace is remotely operated by the melter, who can control from one console the charging, mold transfer, and pouring operations. The melting unit is enclosed in a $^{3}/_{4}$-in-thick airtight and liquid-cooled stainless-steel chamber, with connecting air-lock chambers for charging raw materials and discharging ingots. The design makes it possible to charge, melt, pour, and move ingots without affecting the vacuum in the melting chamber. The mold-handling mechanism makes it possible to cast ingots of varying size and shape, either singly or in multiples from a single heat.

The new unit increases, by 60 to 75 tons, the monthly potential supply of vacuum-melted metal for industry.

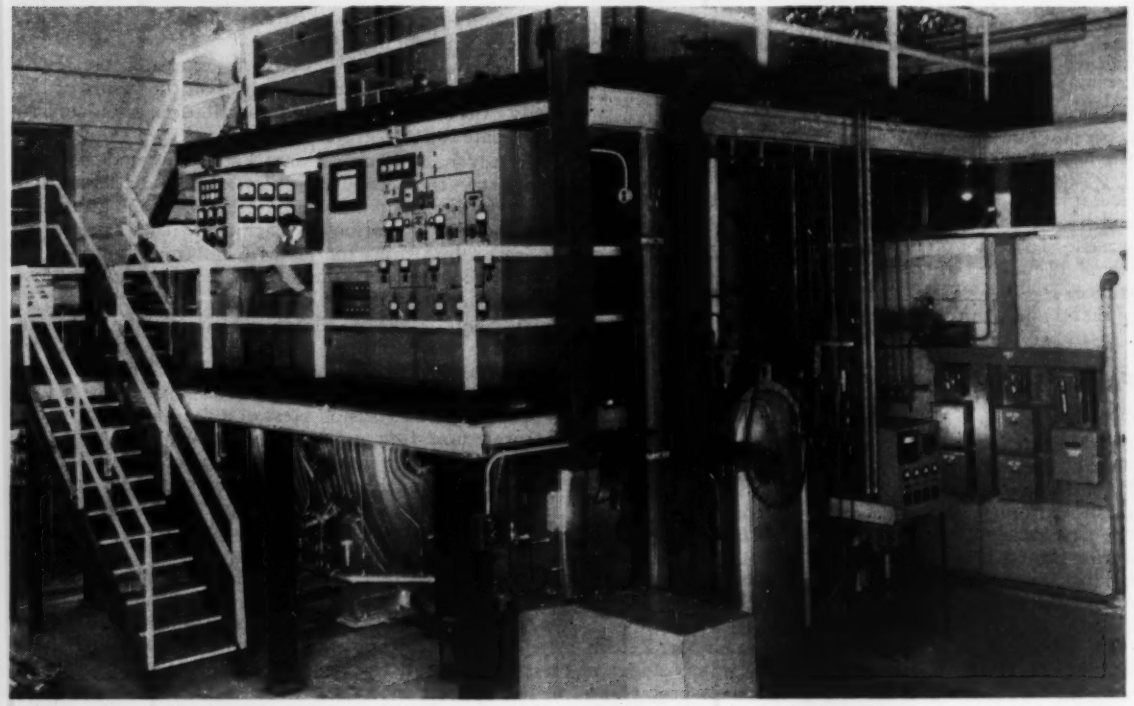
Metals melted in a vacuum are said to be superior to conventional atmospheric melted metals, particularly where such mechanical properties as stress-rupture strength and ductility, fatigue strength, notch ductility, and impact resistance are prime factors.

Experimental evaluations and production trials made from vacuum-melted metals in such industries as aircraft, automotive, electronics, bearing, tool steel, nuclear energy, and others, have prompted Vacuum Metals Corporation to be optimistic about the future and to look forward to providing additional furnace capacity to meet a growing demand for vacuum-melted metals.

## Storm-Surges Project

A STORM surge that came without warning in June, 1954, on Lake Michigan, bringing an 8-ft wall of water and drowning a number of persons along the Chicago lakefront, could have been predicted in time to prevent this loss of life. Another kind of surge—the Atlantic flood of Nov. 6 and 7, 1953, which caused tremendous damage to the Long Island, Staten Island, and New Jersey coasts—likewise could have been anticipated as could many other freak waves, which from time to time have taken a terrific toll of life and property.

This is the contention of three geologists at Columbia University's Lamont Geological Observatory at Palisades, N. Y., who will conduct a three-year project to test their theory that several hours' warning of storm surges can be given. The important project, which is under the sponsorship of the American Institute of Mining and Metallurgical Engineers, is being instituted with an Engineering Foundation grant. In charge of the



**Over-all view of 2200-lb vacuum-melting furnace tapped recently by the Vacuum Metals Corporation at Syracuse, N. Y.**

investigation are Dr. Maurice Ewing, director of the Observatory, Dr. Frank Press, and Dr. William L. Donn.

These scientists believe that when a line squall with its accompanying area of high pressure travels over water at a velocity equal to the normal velocity of a wave of water of the particular existing depth, a resonant effect is produced which can augment the normal wave to disastrous magnitude.

Fortunately, the critical combination of atmospheric disturbance and natural-wave period rarely occurs, but the Lake Michigan surge appears to have been one of these rare instances. While weather in the Chicago area was clear at the time the wave struck, two hours before it struck, the area was visited by a severe squall with winds up to 66 mph. The squall was accompanied by a pressure-jump, or band of increased air pressure. After passing over the city, the squall and pressure-jump traveled 40 miles across Lake Michigan, arriving at Michigan City, Ind. (on the eastern shore directly across from Chicago) simultaneously with a wave from the northeast. Eighty minutes later the reflected 8-ft wave washed back on the Chicago lakefront.

The idea is not completely new. It has been suggested by British scientists as a possible explanation for abnormally high Thames River tides and for a disastrous surge occurring off the Sussex coast in July, 1929. However, the project getting under way at the Lamont Observatory with Engineering Foundation support is the first attempt to formulate a scientific explanation of the Lake Michigan freak wave and to prove the theory of air-to-water coupling.

Since only for equal velocities can a large wave be generated, the project will have to show that appropriate velocities existed at the time of the surge. From U. S. Weather Bureau records of past storms and surges, it is studying surges to see whether appropriate storms existed, and to see whether they generated surges. With these studies as a basis, trial forecasts of lake surges will be made.

The program of course involves continuous monitoring of the kind of atmospheric disturbances Drs. Ewing, Press, and Donn think is responsible for the Lake Michigan type surge. This check on storms will be handled by a new type of instrument sensitive enough to record disturbances that might generate small surges as well as those of more disastrous size. This will mean more case histories to work with. The instrument—made especially for the project and called the Wallace Microbarograph—is being installed at a lake station.

Water-level records must be carefully studied, too, of course. And to be sure of the complete accuracy of the recorder used, the geologists are building their own in the heavy-metal shop the Observatory boasts—a shop equipped for making everything from the most delicate watch spring to a heavy pile driver. The water-level recorder will also be installed at a lake station and operated by the U. S. Lake Survey, which will mail daily records to the Observatory

When the studies of Great Lakes atomospheric disturbance and water levels are well established, the storm-surge investigations will be extended to the coastal oceanic type of flood, with the Atlantic flood of November, 1953, the special case study. After these two studies are completed, the Lamont Observatory geologists expect to investigate surges of both types in the Gulf of Mexico, the Caribbean, and Lake Maracaibo.

If the project confirms their theory, it will probably mean that several hours' advance warning of freak waves can be given on the basis of the position and velocity of a line squall. It may also mean that such waves can be forecast for an area from a study of the occurrence of similar disasters in the past.

The importance of a successful outcome to the program in preventing loss of life—the fishermen warned not to go out, the bathers and coastal dwellers alerted to their danger—cannot be exaggerated. A few hours' warning of disaster would often prevent property loss, too, and would be especially valuable in operations like offshore oil drilling.

## Liquid-Metal Fuel Reactor

Liquid metal as fuel is believed to be technically feasible in the near future and gives promise of being economically attractive, a group of 14 industrial and 3 other organizations has reported to the AEC's Brookhaven National Laboratory, Upton, N. Y.

The group, organized and administered by The Babcock & Wilcox Company, based its study on the liquid-metal fuel reactor concept pioneered by Brookhaven scientists and engineers. The group estimated that a full-scale plant with an electrical capacity of 226,000 kw could be built and operated for a cost of 7.1 mills per kw-hr. This cost is lower than those for large conventional fuel plants in areas of the U. S. where fuel costs are high. If four reactors were built at the same location for a total electrical capacity of 905,000 kw this cost would be lowered to 6.5 mills since initial and operating costs do not go up in direct proportion to added capacity.

The group was organized late in 1954 to explore the economic and technical feasibility of the Liquid-Metal Fuel Reactor (LMFR) system developed at Brookhaven. The group was to survey and evaluate the work already done by Brookhaven and to recommend a future program of research. Babcock & Wilcox provided over-all administration and supervision of the 50 scientists and engineers engaged in the study. About 20 of these were B&W employees.

### Organizations Participating

Organizations providing either full-time or consulting specialists in addition to engineers and physicists provided by Babcock & Wilcox were: Air Reduction Company, American Gas and Electric Company, American Smelting and Refining Company, The Bailey Meter Company, Bechtel Corporation, Carbide & Carbon Chemical Company, The Detroit Edison Company, Dow Chemical Company, The Ethyl Corporation, The International Nickel Company, Inc., Merck & Company, Inc., National Carbon Company, The AEC's Oak Ridge National Laboratory, Rensselaer Polytechnic Institute, Tennessee Valley Authority, and Vanadium Corporation of America. American Gas and Electric and Bechtel participated as representatives of the Nuclear-Power Group and the Detroit Edison Company participated as a representative of the Atomic-Power Developments Associates.

The LMFR system is capable of generating electric power, producing new fuel for itself, and delivering by-products to waste tanks, all in continuous processes. The fuel would be in liquid form, instead of in solid form

as in most reactors, and would circulate within the system. This would be the first usage of a liquid-metal alloy, in this case uranium-bismuth, as the basic fuel.

### Conclusions of Report

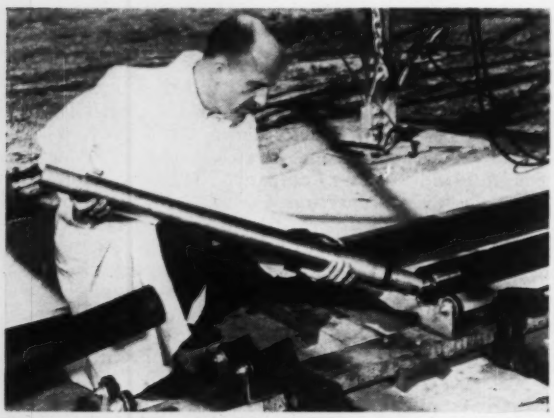
In order to pin-point technical problems which must be solved before a large plant can be built, it was necessary for the group to develop a full-scale preliminary design of the LMFR system. Conclusions contained in the report are based on this reference design, but it was emphasized that improvements can be expected when further mechanical-design and chemical-processing studies are completed.

One of the most attractive features of the system, according to the report, is its flexibility. It can function as a regenerative or as a nonregenerative reactor and, in either case, over a wide range of power outputs. It will also employ complete, continuous chemical processing of both core and blanket materials on the site and can be connected to the most modern turbines, two features which are not found in most other reactor systems.

The report concluded that the critical research and development now required is on the materials which will be used in construction, and on the nuclear stability of the reactor. The group believes that due to the attractive features of the system and the satisfactory research results already obtained, the research program recommended should go forward without interruption.

## Radioactivity Well Logging

RADIOACTIVITY well logging was pushed several strides closer to positive identification and location of oil-bearing formations recently by the first successful test of the world's smallest "atom smasher" by Well Surveys, Inc., Tulsa, Okla. Perfection of this miniature high-energy source by Well Surveys, an affiliate of Lane-Wells Company, one of the Dresser Industries, is one step in the application of atomic energy to oil-field problems begun by the company nearly 20 years ago.



**James A. Cooley of Well Surveys, Inc., Tulsa, Okla., assembles world's smallest atom smasher at well head. Miniature neutron generator used in well-logging studies was developed and constructed for Well Surveys by High Voltage Engineering Corporation, Cambridge, Mass. Instrumentation used with the unit was designed by scientists and engineers at Well Surveys, Inc.**

**Richard Conner, *left,* High Voltage Engineering Corporation, and Thomas Hubbard of Well Surveys, Inc., compare size of laboratory particle accelerator with baby accelerator, both built by the High Voltage organization. The larger unit, 4 ft in diam and 6 ft long, dwarfs the smaller neutron generator which is only 3 in. in diam and 47 in. long.**

This unique neutron generator, incorporated in a standard of $3^{5}/_{8}$-in. well-logging assembly, is itself only 3 in. in diam and 47 in. long, yet has been developed to provide the most intensive beams of neutrons ever used in a well. The device actually is a miniature version of a Van de Graaff particle accelerator, a large radiation-generating machine long used for physics research, cancer therapy, and more recently for chemical processing and sterilization.

The "baby" accelerator was developed and constructed by High Voltage Engineering Corporation, Cambridge, Mass. The complex instrumentation used with the neutron source has been developed by Well Surveys' scientists and engineers.

The miniature Van de Graaff generates electrical potentials up to 2,000,000 volts which are used to produce a stream of atomic particles called deuterons. These particles, actually the nuclei of heavy hydrogen atoms, are fired into a target of tritium (super-heavy hydrogen). The collision of deuterons with tritium atoms produces an intense yield of neutrons.

These neutrons, traveling at extremely high speeds, penetrate the earth's formations surrounding a bore-hole and cause various nuclear reactions in the material encountered. These reactions, in turn, yield atomic particles and rays which can be identified and measured by sensitive radiation-detection equipment which accompanies the accelerator down the hole.

The resulting information, transmitted to the surface and recorded, when correlated with the results of neutron-radiation research performed with the large half-million-volt accelerator in Well Surveys' laboratories, will be extremely useful in the identification and evaluation of formation constituents.

Further development of this unique type of equipment represents the only known scientific approach to the eventual positive identification and location of oil at great depths, in new or existing bore-holes, a long-sought goal of oil men everywhere.

Preliminary tests have already been run in the Well Surveys, Inc., test well at Tulsa. An intensive test pro-

gram for both the neutron source and accompanying instrumentation will be accelerated through the coming months, according to the company.

## Atomic Food Preservation

FRESHER and tastier food may be in the offing for soldiers in the field as the result of studies being made by Atomics International, a division of North American Aviation, Inc., under a U. S. Army Quartermaster Corps contract to determine the most practical means of preserving food by atomic radiation.

The studies, to be completed in one year, are concerned with four objectives of food radiation:

1 The reduction of field refrigeration by the use of radiation sterilization or pasteurization.
2 An improvement in the quality of canned foods.
3 The deinfestation of grain, dried solids such as powdered milk, oatmeal, etc.
4 The irradiation of foods to prevent sprouting.

While the studies are being made primarily from the standpoint of military economic and logistic feasibility, possible commercial applications are also being explored. Under the contract, the company is not seeking to develop new means of preserving foods by radiation, but is analyzing from an industrial standpoint methods already proposed or under way.

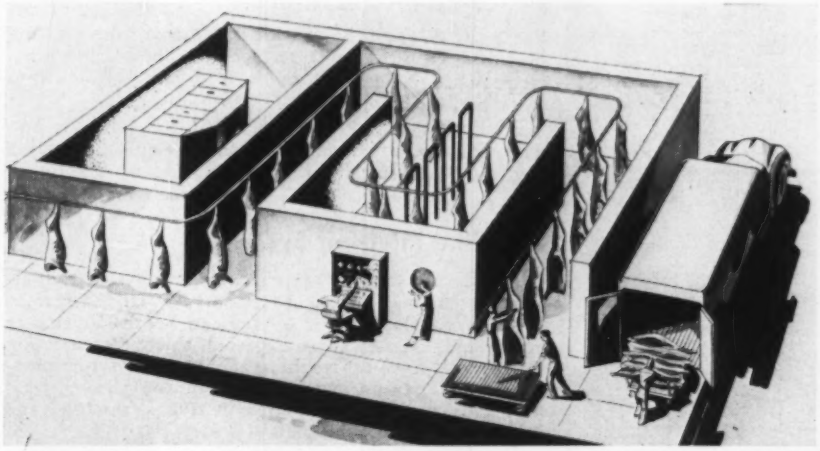
The investigations concern such matters as the most practical way food might be kept longer under refrigeration during shipment or storage and how the keeping qualities might be improved after the food has arrived at its destination. The economic and technical aspects of the ways in which the various methods of irradiating foods might be integrated into a processing plant are also being explored.

The principal sources of radiation being considered for the food-preservation study are electron accelerators, radioisotopes, used reactor fuel elements, direct nuclear-reactor radiations, and radiation from reactor coolants. Bacteria which cause food spoilage are destroyed by these types of radiation without raising the temperature of the foods. Conventional preservation methods using heat destroy much of the vitamin content of food and often change the texture of the product.

Radiation preservation is also expected to lengthen the "shelf life" of fresh meats, extending the time meat can be kept in conventional display counters.

Studies to determine methods, designs, and cost estimates for incorporating radiation-preservation equipment into conventional food-handling practices and machinery will be included.

Two research reactors now in construction by Atomics International are expected to be used for radiation-preservation studies, although their primary purpose will be for other applications. These reactors are the medical research machine for the University of California at Los Angeles Medical Center, and an industrial research reactor for Armour Research Foundation, Chicago, Ill.



**Artist's sketch illustrating one way fresh meat can be preserved by atomic radiation. Nuclear reactor, *left,* produces fission products which are circulated to radiation area, *center.* Beef enters processing unit at *left,* passes through radiation area, *center,* where bacteria causing food decay is destroyed, and moves to *right,* where packing and shipping operations are completed.**

## Steam Power Plants

KYGER Creek Plant on the Ohio River at Cheshire, the largest electric power plant in Ohio, is now in full operation. It was completed more than three months ahead of schedule.

The fifth and last of Kyger Creek's 215,000-kw steam turbine-generators has been placed in operation, according to the Ohio Valley Electric Corporation. Some construction work and final details remain, however, to be completed. At 1,075,000 kw, the station is the largest in the Buckeye State and the second-largest power plant ever built anywhere by private enterprise.

Kyger Creek and Clifty Creek Plant, its sister station located at Madison, Ind., also on the Ohio River, were built by OVEC for the single purpose of supplying the full and tremendous electric-power requirements of the U. S. Atomic Energy Commission's giant new Portsmouth (Ohio) Project. Five 215,000-kw units also are in operation at Clifty Creek. Operation of the sixth and final unit there is scheduled for this month and will give Clifty Creek a total capacity of 1,290,000 kw, making it the world's largest private power plant.

The outstanding aspect of the construction job at both plants probably has been the speed with which it is being carried out. OVEC was organized only three years ago. Ground was broken at both plant sites in December, 1952. The first generating unit at each plant was placed in commercial operation in February, 1955. The final unit—the 11th in all—is scheduled for this month.

This will mean that OVEC will have placed

2,365,000 kw of electric-power capacity in operation in 12 months' time—the installation of more power in so short a period than ever before accomplished in the history of the electric-utility industry.

Of even greater importance, the entire job is well ahead of its original schedule. For example, Kyger Creek's Unit 5—now in operation—was scheduled for next April 1; Clifty Creek's Unit 6 was scheduled for June 1.

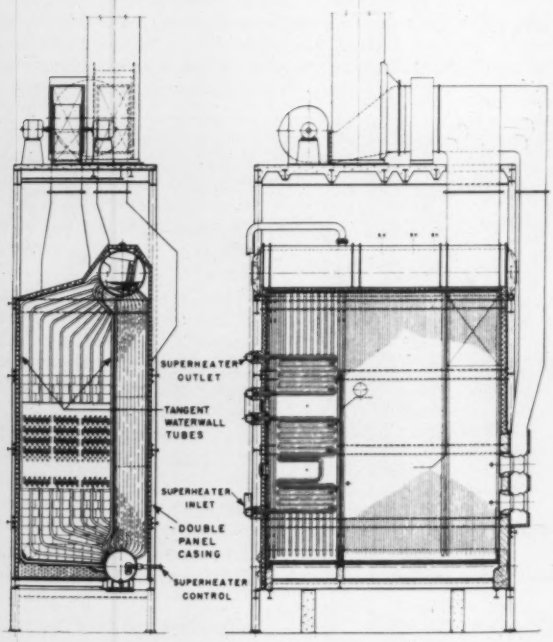
Some idea of the size of this accomplishment can be judged from the fact that only 15 of our 48 states today have total electric-generating capacities, both public and private combined, which exceed OVEC's capability of 2,365,000 kw. In terms of power production, OVEC will generate annually more electricity than is currently consumed in a year in New York City.

## Headerless Steam Generator

A NEW development in specially designed, field-erected headerless-type steam generators of capacities ranging from 50,000 to 150,000 lb of steam per hr, has been announced by Springfield Boiler Company, Springfield, Ill. Units are of a new design that is remarkably lower in initial cost, easier and less expensive to maintain, and affords greater compactness. Units are highly efficient and can be built for either pressurized or balanced draft firing. Heat recovery for higher efficiencies and superheat equipment can be provided as desired.

Superheater headers and steam temperature control lines are on the outside of the unit for ready access and are drainable.

The design consists of a two-drum, bottom-supported boiler with completely water-cooled furnace having tangent-tube spacing on bottom, both sides, and roof, and a wider tube spacing as required in the front wall to permit burner installation with a tile backed-up target wall opposite the burners. This target wall is tube-cooled with wall tube spacing arranged to form a furnace screen ahead of the superheater.




**Cross-section drawings of 125,000-lb headerless-type steam generator**

The design employs no waterwall and no boiler headers. Water-steam friction losses are reduced to less than one quarter of that of conventional designs. Thus virtually all of the hydrostatic head is available to support rapid circulation through tubes. Such rapid circulation adds greatly to the washing and cleaning effect that high-velocity water provides inside of the waterwall and boiler tubes. Installations are completely self-draining, including boiler, waterwall, economizer, and superheater tubes. Units can be provided with steam-temperature control of either the submerged heat-exchanger type or the spray type. The top drum of the unit is provided with an effective steam purifier.

The unit is bottom-supported; thus all structural members have low unit stresses. Expansion of pressure parts and outer casing is taken care of by seal-welded expansion joints. The casing closure is of a double-casing design with the internal casing floating on supports attached to the outer casing. Tube anchors and guides are carried on structural members of the outer casing in such a manner that free expansion can take place. The outer casing is completely seal-welded and thus can be checked against leakage by pressurized fog tests at any time. Any tube within the unit can be replaced without removing any other tube, merely by removing panel sections from the casing. The removal and replacement of the casing panels and seal rewelding of the outer casing can be done by mechanics, without involving any refractory or insulation work.

The separation of pressure parts from setting enclosure and the employment of scientifically developed tube joints with a specific grooving and tube seat depth on the water side of the drums, together with the continuous tube design, make this type generator a quick starter and a quick steamer.

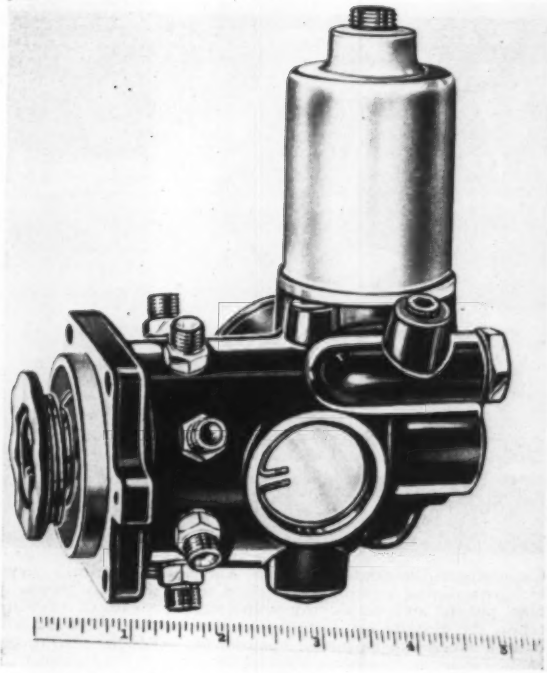
Drain space and leakage test space are provided below the furnace floor. The furnace-floor tubes are covered by a layer of tile to prevent steam lane formation on the top of the tubes and to provide ignition support for combustion. Pressure-tight access and observation ports are provided for access between the boiler tube banks, into the superheater space, and into the furnace.

Elimination of all headers, with consequent elimination of many tube joints and handhole openings, makes this type unit suitable for quick chemical cleaning.

## Gasoline Injection System

THE development of a practical new gasoline injection system was announced recently by the American Bosch Arma Corporation's American Bosch Division in Springfield, Mass. It is expected this new injection system will have far-reaching effects on the future progress of the gasoline engine, first in the passenger-car field and later in engines used in trucks, tractors, and other automotive applications.

The American Bosch system consists of an exceptionally small and simplified fuel-metering and injection pump, a mixture or fuel-air-ratio control, an electrically driven fuel-supply pump, injection discharge lines and nozzles, and a fuel filter.



**American Bosch Division's gasoline injection pump and control**

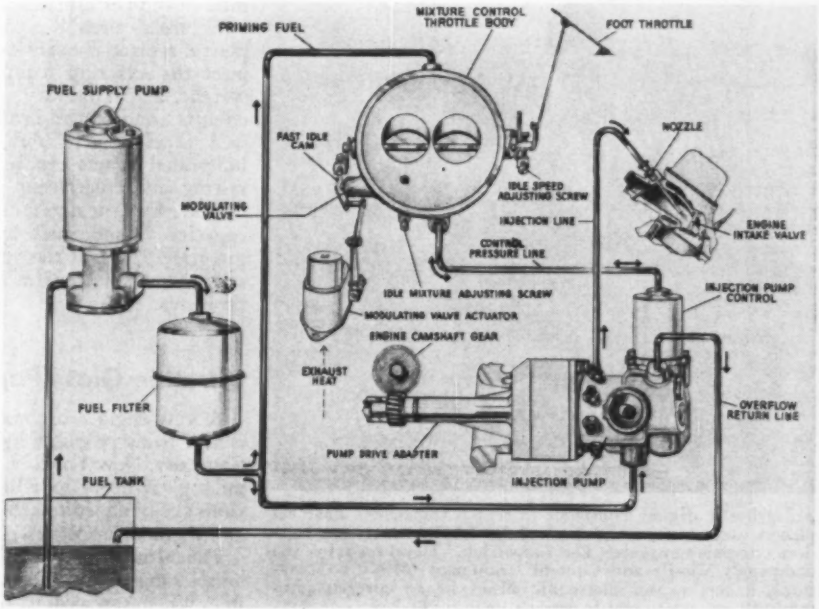
A motor-driven supply pump supplies fuel through a filter to the injection pump maintaining fuel pressures well over the service vapor pressure of gasoline. The filter traps any harmful particles in the fuel down to 2 microns in size and has a service life of approximately 30,000 miles of normal car operation.

The injection pump is a simplified single-plunger type with the plunger reciprocated by means of an integral face cam to pump the fuel and at the same time rotating to distribute fuel to each cylinder. The positioning of a sleeve on the plunger controls the amount of fuel injected. A control mechanism is attached to the injection pump which receives a control pressure from the mixture control and translates it through a shaft to the plunger's metering sleeve.

The mixture control is a manifold-pressure type with throttles linked directly to the accelerator pedal. A chamber in the mixture control feeds a modified manifold pressure to the injection-pump control during cold starting and idling. Injection nozzles are of the simple poppet type. In the present system these are located in the manifold directly above each intake valve. Fuel is sprayed toward the back of each valve and carried into the cylinder by the air during the intake stroke.

The new system has many potential advantages over carburetion, according to American Bosch. More accurate fuel distribution to each engine cylinder results in improved fuel economy since no cylinder is obliged to run too rich in order to insure that none runs too lean. This also means there is much less dilution to the engine lube oil and consequent less wearing of the engine's vital surfaces. Furthermore, with certain controls incorporated in the system, an idling or decelerating engine runs much less rich than a carbureted engine.

American Bosch reveals that with its new system, the available peak horsepower of a standard engine is increased approximately 10 per cent. In addition, a corresponding increase in the torque at lower speeds occurs. Peak torque developed by the engine is lowered about 500 rpm and the torque curve flattens. Acceleration is improved because of more instant response to fast or slow throttle movements. An improvement of from 5 to 15 per cent in miles per gallon can be realized in road-load performance. Because it is a pressurized system, less expensive high-vapor pressure fuels may be used,




**Schematic view of new American Bosch gasoline injection system**

yet there is greater freedom from icing vapor usually associated with a carburetor.

One advantage that will appeal to automobile designers is that with gasoline-line injection the headroom requirement in the engine compartment can be reduced 4 to 6 in. or more which will allow for lower hood lines and changes in body styling.

It should be emphasized that all gasoline injection development work at present has been done with standard automobile engines. American Bosch has not as yet had available for testing an engine specifically designed to take the greatest advantage of its new system. It is expected that with such a specifically designed engine, at least 25 per cent more output horsepower can be obtained plus a marked improvement in economy of operation.

## Airborne Digital Computer

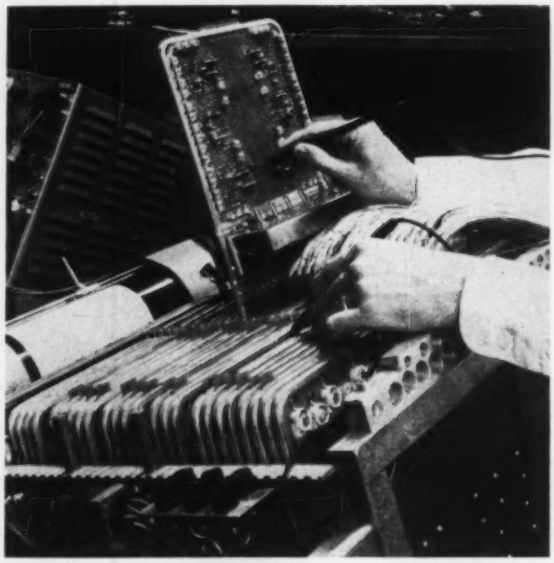
AN AIRBORNE digital computer in which transistors have replaced vacuum tubes has been developed and successfully flight-tested by North American Aviation's Missile and Control Equipment (MACE) Operations for the U. S. Air Force, it was announced recently.

Acting as an "electronic brain" in an aircraft, the computer automatically and continuously processes in-flight data. It can solve a number of mathematical problems in one second. An engineer would have to work nine hours to solve the same problems with pencil and paper.

Miniaturization techniques permitting use of some 1000 transistors instead of vacuum tubes and "etched" circuits in place of conventional wiring, give this computer many advantages over conventional ones.

It is more compact, occupying only 3 cu ft and weighing only 125 lb. A similar vacuum-tube computer with only one-half the capacity is four times heavier and would fill an average closet.

**An airborne digital computer in which transistors have replaced vacuum tubes is checked by North American Aviation computer engineer Les Kilpatrick. Developed by the company's Missile and Control Equipment (MACE) Operations, it acts as an electronic brain in an aircraft automatically and continuously processing in-flight data.**



**Circuits are checked in North American Aviation's new airborne digital computer. Etched from sheets of copper-clad plastic and employing transistors instead of vacuum tubes, the circuits are designed in the form of standardized panels which can be pulled out like file cards for testing or replacement.**

Requiring less power to operate, the North American computer uses less than 100 watts. A similar vacuum-tube device with one-half the capacity consumes 3000 watts.

Offering greater operational reliability under service conditions, it is especially designed to withstand rigorous environmental conditions experienced in present and future high-performance aircraft.

Electrical circuits etched from sheets of copper-clad plastic replace conventional wiring in the computer to meet the exacting requirements of compactness, light weight, and reliability. The etched and transistorized circuits are designed in the form of 51 highly standardized panels for reliability and quick servicing. The individual panels can be pulled out like file cards for testing and replacement.

In mathematical terminology, this airborne-computer's capacity is indicated by its ability to continuously integrate 93 quantities simultaneously. It can generate continuous solutions of differential and trigonometric problems.

## Ultrathin Glass Paper

A NEW engineering material called "Tissuglas" paper is now being produced by American Machine & Foundry Company, New York, N. Y. The material is essentially microglass fibers to which a binder and/or impregnations can be added to achieve desired electrical, chemical, and thermal properties.

The ultrasoft, tissuelike film is available in thicknesses ranging from 0.5 to 13 mils and widths up to 40 in. When specified, the binder utilized is insoluble in

aqueous and most organic solvents. Impregnations used successfully to date include melamine, epoxy, silicone, polyvinylchloride, polytetrafluoroethylene, and polyester preparations.

The plain Tissuglas paper can be as much as 95 per cent air by volume, thereby providing industry with a carrier sheet composed of up to approximately 95 per cent resin and the balance inert carrier. Wet strength is approximately 70 per cent of dry tensile which ranges from 95 to 880 psi; breaking strength varies from 200 to 1350 grams per inch of width. Chemical and thermal properties are, to a great degree, determined by the basic glass fibers in combination with the particular impregnation used.

Potential applications include surfacing sheets for high and low-pressure laminates, as well as backing material for a wide variety of other volume-production sheet products, notably mica.

## Improved Incandescent Lamp

THE greatest single improvement in incandescent light-bulb performance in 42 years was announced recently by General Electric Company at Nela Park, Cleveland, Ohio. Developments now being placed in effect will cause increases in light output ranging from 6 per cent for household bulbs to 15 per cent for higher-wattage bulbs used in industrial and commercial lighting. No more electricity is required.

The light bonus produced by each bulb as a result of the improvements is seen as worth the entire cost of the bulb to users. Ultimately, the benefit to American consumers in the form of increased light can amount to more than $100,000,000 annually.

In addition, the better bulbs are expected to contribute importantly to improved incandescent lighting for homes, factories, offices, stores, schools, and the like.

The improved lamp in the 750 and 1000-watt sizes, which offer the greatest benefits, will be available immediately. The new developments will be extended to other sizes within the next few years, as rapidly as equipment can be built and installed to mass-produce the hundreds of millions of bulbs used annually.

The increased light output is achieved by the following steps: (1) Improving the tungsten filament by making basic design changes; (2) altering the mount structure, so that the filament is positioned lengthwise, or axially, in the bulb; and (3) substituting for the first time coiled-coil filaments for singly coiled ones in lamps of 300 watts and larger.

As a result of these construction changes, lamps of 300 watts or larger will have an increased light output over their lifetime of 15 per cent.

In the case of household sizes, which already have the benefits of coiled-coil filaments, the light-output increase will amount to at least 6 per cent.

## Radar Gravity Switching Yard

A NEW $7 million gravity switching yard, termed one of the most modern in the United States, was dedicated this month by Southern Pacific Lines at Houston, Texas. See photo story, pages 166 and 167.

The new "hump yard" is four miles long and 1500 ft wide with a 27-ft crest and a maze of switches leading to the 48 classification tracks. The yard is the first of its kind to be built in the Southwest, and is equipped with radar-activated car-braking equipment. See frontispiece on page 130.

In addition to the 48 classification tracks that will accommodate 2740 cars, the yard has 11 receiving tracks for 1311 cars, 12 departure tracks for 1409 cars, a 10-track local make-up unit for 849 cars, five tracks for storing and holding of cars that will handle 200 cars, four interchange tracks for 395 cars, and three car-cleaning and upgrading tracks for 150 cars.

The new yard is equipped to handle 3500 to 3800 freight cars in a three-shift operation and incorporates a dozen or more of the latest features developed by the General Railway Signal Company of Rochester, N. Y.

Automatic car retarders check each car to see how it rolls, compute how fast each piece of equipment must move based on weight and rollability, and then controls the car speeds so that each car is handled at safe coupling speeds.

By pressing a button on the control panel, the crest tower operator can route a freight car to any of the 48 classification tracks 500 ft away. Once the car clears the crest and starts down the incline, however, the entire operation is automatic. The electric brain "remembers" the route established for each car, or cut of cars if they are for the same destination, and sets the switches as the equipment passes over each separate track.

The new equipment saves more than two hours of switching time on each train passing through the Houston yard and more than doubles the capacity of the yard which previously handled an average of 90 yard trains and yard transfer cuts a day in and out.

Key to the yard is the equipment that slows fast-moving cars and cuts off cars to just enough momentum to carry them down the tracks to the lower end where "skates" stop them at desired locations.

The equipment is highly electronic with radar speed-determining devices and weight detectors built into the retardation units to determine automatically the amount of pressure that must be placed upon the flanges of the car wheels to slow them down.

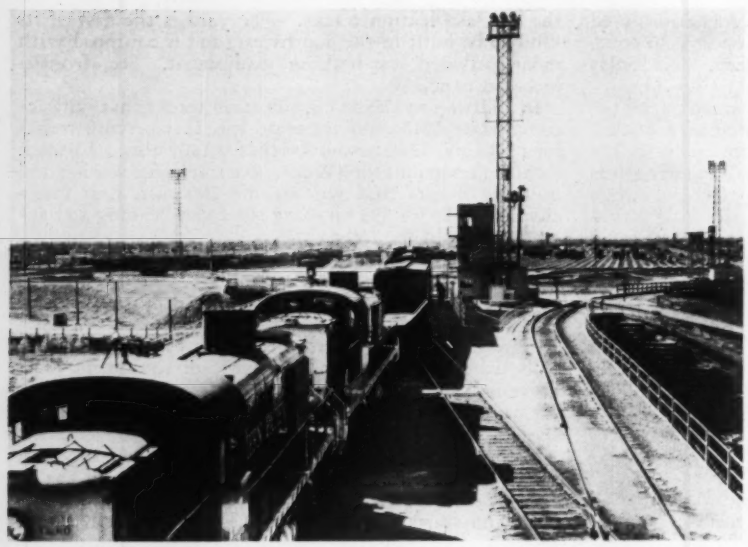
As the cars enter the group retarders they are moving from 13 to 15 mph, but when they leave the retarders they are slowed to from 4 to 6 mph depending upon their weights and ease with which they roll. The master retarder is about six car lengths and the group retarder units each about two cars long.

Incoming freight trains due for classification are moved to the crest of the hump at the east end of the yard. The crest conductor at that point checks off the cars to be sent. By pushing a button on the control board he sets up the routing for the car or string of cars, as the case may be.

The retarder operator monitors the automatic system and has at his finger tips normal control levers to take over operations in event of an emergency.

Diesel locomotives in the lower part of the yard pick up the strings of cars and rearrange them into new trains. Thus classified as to destination, the cars may be set out at their destinations without more than one additional switching operation and with a minimum of time.

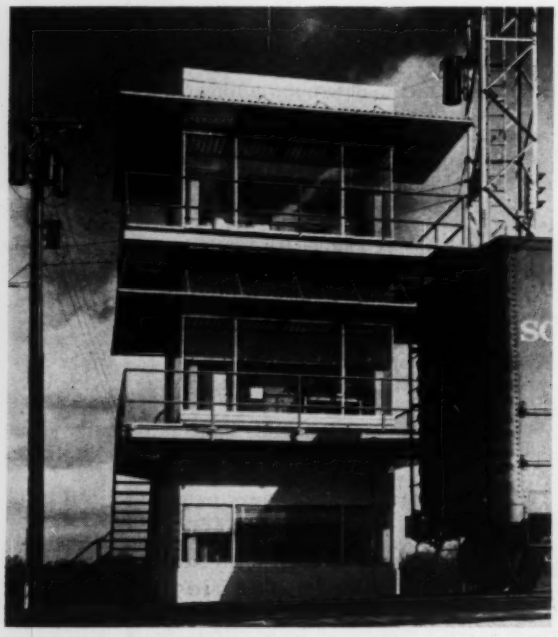
Nerve center of the entire operation is the bowl yardmaster's office. Through his windows he can watch the entire yard and has all operations at his finger tips. Radio, loud speaker, and conveyer-tube systems converge there.



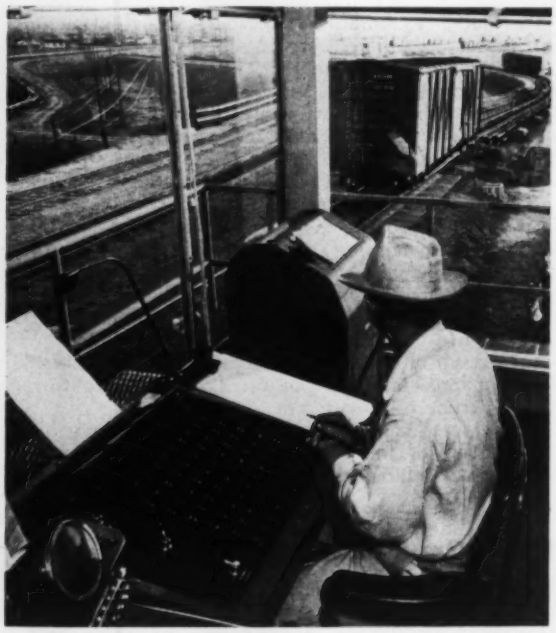
Two 1700-hp diesel locomotives push a string of freight cars to the crest at Southern Pacific's new electronic yard at Houston where they roll under gravity to the classification tracks. En route down the grade, movement of cars is controlled by radar-activated brake retarders.

# Southern Pacific Lines . . .

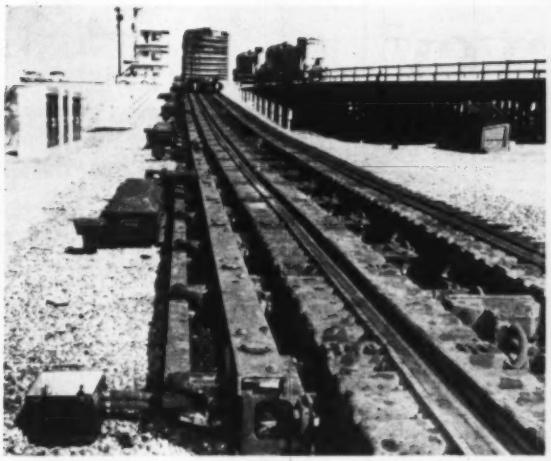
## . . . new radar gravity switching yard



South elevation of crest control tower housing Scalemaster and automatic scale equipment on first floor, automatic switching push-button panel board on second floor, and crest Yardmaster on third floor



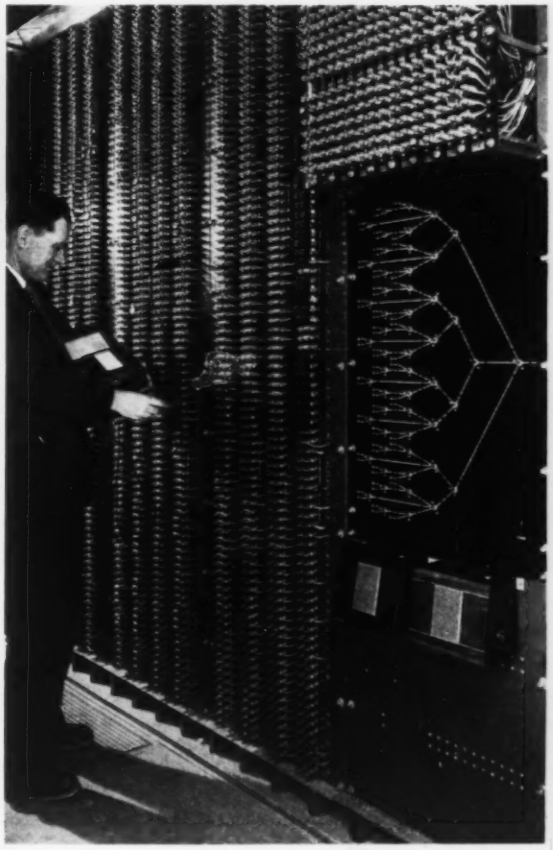
Crest engine foreman pushes buttons that control automatic switching of cars. He can line up as many as four different routings at a time, keeps well ahead of cuts of cars moving down crest to classification tracks.



Freight car starts down crest on its way to classification track. En route radar waves sent out from the speed-detector units between the rails strike the approaching car and bounce back to the antennae which relay them to the electronic equipment that controls retarder braking action.

Nerve center of the entire yard operation is this bowl tower located near the center of the new facilities which extend four miles long and 1500 ft wide. Assistant Yardmaster is shown here directing switching of cars from classification tracks for the make-up of outbound trains.

*Above:* Electronic scale weight-recording apparatus for automatic track scale

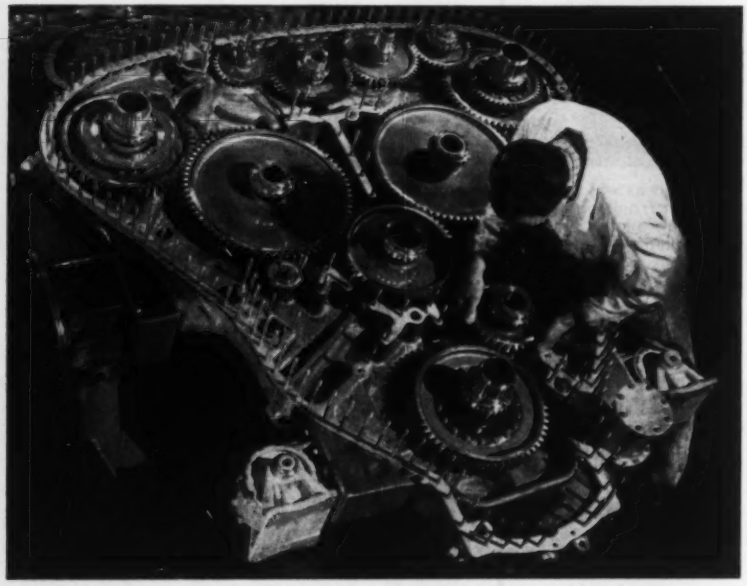


*Right:* D. W. Morris, supervisor of signal construction for Southern Pacific, makes a test of relays and wiring on the automatic switching relay panel. This maze of circuits controls the automatic switching of cars after the crest engine foreman has lined the track for a specific movement. Another set of electronic equipment governs the automatic brake retarders which are operated by radar.

# European Survey

## Engineering Progress in the British Isles and Western Europe

J. Foster Petree,[1] Mem. ASME, *European Correspondent*



**Fitting final gear of opposed-piston compression-ignition Deltic engine having three banks of cylinders in the form of an equilateral triangle**

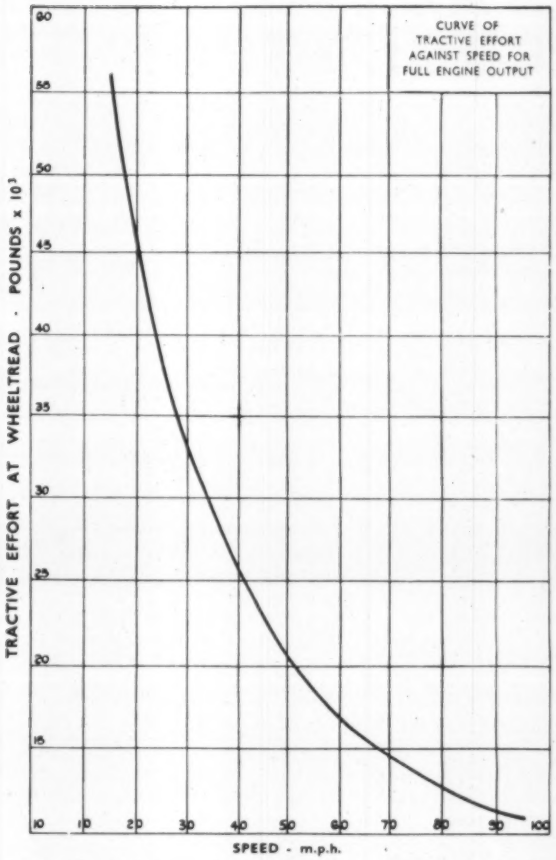
### The "Deltic" Engine

In the description of the 3300-hp diesel-electric locomotive now undergoing tests on British Railways, which appeared in the December, 1955, "European Survey," it was stated that this locomotive, constructed by the English Electric Company, was powered by two Napier Deltic two-stroke oil engines made by D. Napier & Son, Limited, of Acton, England, a member firm of the English Electric Group. This engine is of such an unusual design that some further particulars may be of interest, to supplement the illustration in the December issue.

The cylinder arrangement, in cross section, is in the form of an equilateral triangle, point downward, each side being a long cylinder containing two opposed pistons. The three six-throw crankshafts are positioned at the three angles of the triangle and two pistons, one in each of the adjacent cylinders, act on each crankpin. The bottom crankshaft rotates in the opposite sense to the other two, and all three are coupled through gearing to a central output shaft. The layout results automatically in a phase-angle difference of 20 deg between the exhaust and inlet crankshafts, which facilitates an extremely efficient arrangement of ports for scavenging and for cylinder charging. The triangulated unit forming the main body of the engine consists of three identical cast-aluminum 6-cyl blocks (these are the sides of the triangle) and three cast-aluminum crankcases at the corners, the whole held together by through-bolts of high-tensile steel which carry all combustion loads, the cylinder blocks remaining in compression. The lower crankcase is deeper than the other two to provide the engine bearers and an oil sump.

The over-all length of the engine is 10 ft 11 in., the width 6 ft 2 $\frac{1}{2}$ in., and the height 7 ft 1 in. The cylinders have a bore of 5 $\frac{1}{8}$ in. and the piston stroke is 7 $\frac{1}{4}$ in., giving an effective capacity of 86.9 litres. The piston speed at 2000 rpm is 2416 fpm and the net dry weight is 8725 lb, or 3.5 lb per hp. The "wet-type" cylinder liners are machined from hollow steel forgings and are chromium-plated and finished by lapping. The exhaust ports are machined round about half of the circumference at one end of the cylinder, the bars between the ports being watercooled, and the inlet ports at the other end go round the whole circumference. The inlet ports are

[1] Correspondence with Mr. Petree should be addressed to 36 Mayfield Road, Sutton, Surrey, England.




**Curve of tractive effort against speed for full Deltic engine output**

machined with a partly tangential entry, to give a swirl to the inlet air. Two injectors are provided for each cylinder. The pistons are made in two parts, the inner member being an aluminum-alloy forging in which the hardened steel gudgeon pin is tightly fitted. The outer member is of cast aluminum, with a cast-in insert of austenitic iron in which the two top rings are mounted. The two parts of the piston are held together by a Circlip. The crowns are oil cooled.

The connecting rods are high-tensile steel stampings, machined all over. The pair of rods working on each crankpin are of the fork-and-blade type, the big end of the forked rod having a steel shell, nitrided on its outer surface which forms the bearing for the blade rod. The bearings are of the Vandervell steel-strip type, lined with lead bronze and lead plated. The crankshafts are nitrided all over, the bearing surfaces being finished by lapping.

Cylinder cooling is by distilled water, circulated through a heat exchanger by a centrifugal pump on the engine. The three crankshafts, as stated, are coupled through a gearing system, so designed that the output shaft runs at slightly more than crankshaft speed. The connection between each crankshaft and its gear train is made through a flexible quill shaft. Scavenge air for the engine is supplied by a single-stage double-sided centrifugal blower, delivering through a diffuser into a casing having three exits, one to each bank of cylinders.

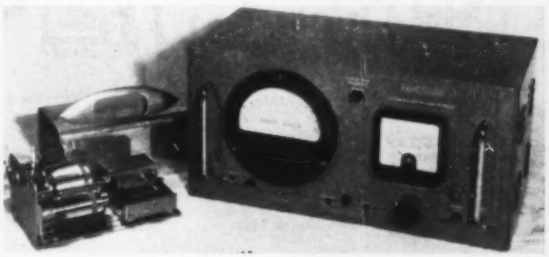
Cartridge starting is used, the cartridge firing into a cylinder containing a piston mounted on a helically splined shaft carrying a Bendix type claw coupling.

The experimental engine has been in service for some time, hauling the Merseyside Express between London and Liverpool.

## Balancing Turbine Rotors in Place

THE expense involved in removing a marine-turbine rotor from a ship for rebalancing, in cases where an out-of-balance condition has developed in service, led the Pametrada Research Station to devise a simple and effective system whereby a rotor can be rebalanced on board ship in its own bearings and at low speeds.

The method is to measure the bearing pedestal vibrations caused by the unbalance forces and the phase angle of those forces with respect to a reference mark on the rotor. The pedestal vibrations are detected by an electromagnetic pick-up which is not activated directly by the pedestal, but by a tunable mass-spring system which can be adjusted to resonate at the turbine-rotor speed of about 500 rpm. The vibrations at this speed are magnified to about 30 times above normal. The pick-up generates a voltage output proportional to the velocity of the vibrations, so that its output consists almost entirely of the rotor-speed frequency and is in phase with the out-of-balance force causing the vibrations.



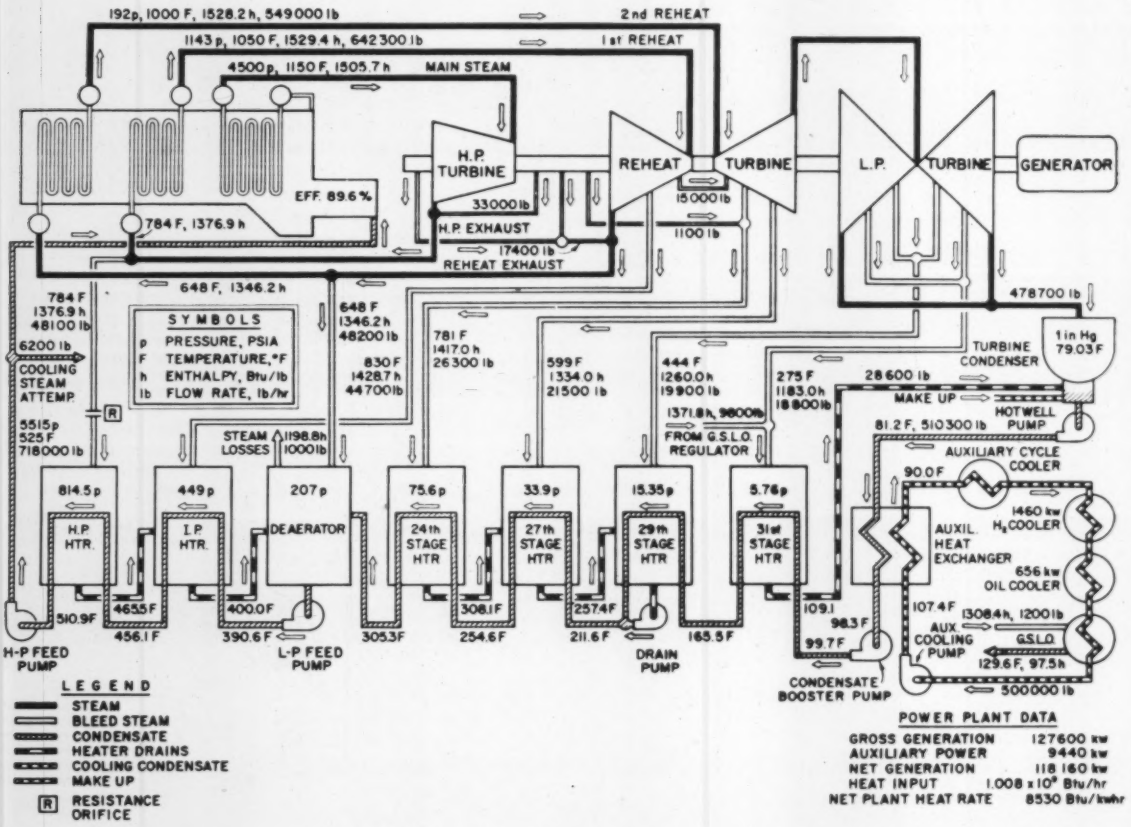
**Apparatus for rebalancing marine-turbine rotors on board ship, developed at Pametrada Research Station**

This voltage is amplified and registered on a meter calibrated in thousandths of an inch per second, thus indicating directly the root-mean-square value of the vibration velocity of the bearing pedestal. The position of the out-of-balance resultant force at a bearing is found by measuring the phase angle of the voltage generated by the pick-up at that bearing with respect to a reference-voltage pulse, generated once per revolution by the passage of an impulse pin on the shaft past a small electromagnetic coil attached to the turbine casing. The phase angle is indicated on a meter scaled from 0 to 360 deg.

By these means, all the necessary information is obtained to enable the balance of the rotor to be restored. The final degree of balance attainable is similar to that afforded by a shop-balancing machine.

# ASME Technical Digest

## Substance in Brief of Papers Presented at ASME Meetings




**Final heat balance, giving a heat rate of 8530 Btu per kwhr, of first commercial supercritical pressure steam-electric generating unit for Philo Plant**

## Steam Power Generation

**First Commercial Supercritical Pressure Steam-Electric Generating Unit for Philo Plant,** by S. N. Fiala, Mem. ASME, American Gas & Electric Service Corporation, New York, N. Y. 1955 ASME Diamond Jubilee Annual Meeting paper No. 55—A-137 (multilithographed; to be published in Trans. ASME; available to Oct. 1, 1956).

THIS paper describes the essential features of the 125-mw supercritical pressure unit now being installed at the Philo Plant of the Ohio Power Company, a member of the American Gas and Electric System.

In the design of the Philo unit, it was desired to use the maximum combination of temperature and pressure justifiable, since the basic premise of the project was the close relation and interdependence of the two. An operating pressure of 4500 psi was then selected not only because of its apparent optimum relation to 1150 F but also because it gives operating pressures in the feedwater-heater lines, boiler, and steam lines which are within the limits of presently established codes.

The Philo steam generator, designed and built by Babcock & Wilcox, is rated at 675,000 lb per hr at 4500 psi and 1150 F with a feedwater temperature of 525 F. There are two reheat sections; the first will raise 655,000 lb per hr at 1225 psi from 800 F to 1050 F; the second will raise 520,000 lb per hr at 185 psi from 630 F to 1000 F. The unit has an estimated capability of 740,000 lb per hr at the main steam conditions.

The arrangement of the steam generator consists of cyclone-fired furnaces in front of pendant superheaters and reheaters. The walls of the cyclones and the front wall of the primary furnace are cooled by incoming feedwater. The transition from water to steam occurs in the primary superheater in the coolest gas zone. The remainder of the wall and pendant

surface is superheater surface. The final superheater is arranged across the width of the furnace. The convection pass is divided by a baffle with the primary superheater on one side and the two reheat sections in series on the other. Gas flow is proportioned by dampers at the outlet of each side. By control of firing rate, main steam temperature will be controlled and by positioning these dampers, one of the two reheat temperatures will be controlled.

The General Electric 3600-rpm, tandem-compound, double-flow turbine is rated 125,000 kw at initial steam flow of 675,000 lb per hr at 1150 F and 4500 psi. At full load steam is expanded from these initial conditions to 1225 psi and 800 F in a double-shell high-pressure turbine. The steam is then reheated in the boiler to 1050 F and expanded through the first reheat turbine to an exhaust condition of 185 psi and 630 F. The steam is again reheated, this time to 1000 F, and then passed through the second reheat turbine and the double-flow low-pressure turbine. The double-flow turbine is equipped with 26-in-long buckets in the last stage.

Condenser design is directed at obtaining the maximum possible freedom from seepage leaks. Among other arrangements, sprayed-rubber coatings are to be applied to the tube sheets to seal off the rolled tube ends. 70–30 cupronickel tubes were selected as suitable to withstand the high pH conditions on the steam side and the conditions met on the circulating-water side so as to minimize tube failures. Similarly, feedwater-heater tubes will be, for the most part, fabricated of 70–30 cupronickel.

A multipurpose demineralizer with a capacity of 100,000 lb per hr is provided. This can be operated either continuously, by-passing about 20 per cent of the condensate to maintain solids at a minimum or, during start-up or shutdown of the steam generator, to remove any solids which might wash out during these transient conditions. This latter condition of start-up and shutdown governs the capacity of the demineralizer.

An external recirculating system is required with a once-through-type boiler to replace the natural circulation which exists in a conventional boiler even during start-up. Condensate, hot water, and steam must be disposed of until the steam at the superheater outlet is at a condition suitable for starting the main turbine. To protect cyclone and furnace-wall tubes we have adopted the basic operating maxim of not firing unless at least 225,000 lb per hr of water is circulating. This was based upon a minimum water velocity of 7 fps through the cyclone tubes. Interlocks have been provided to shut off all fires if flow should at any time drop below this minimum amount.

The recirculation system is one of the major points of difference between a conventional boiler and the once-through-type boiler. The design of this system represented one of the most challenging problems associated with the design of the unit as a whole. All equipment must be designed for completely tight shut-off against full pressure and temperature conditions. In operation, the piping and valves must withstand pressure drops from 4500 psi down to 150 psi at all temperatures between room temperature and 1150 F. In starting up and in passing through this spectrum of temperatures, the valves must pass first a waterlike phase, later steam which flashes wet and then dry again, and finally completely superheated steam. This imposes particularly severe service on these valves.

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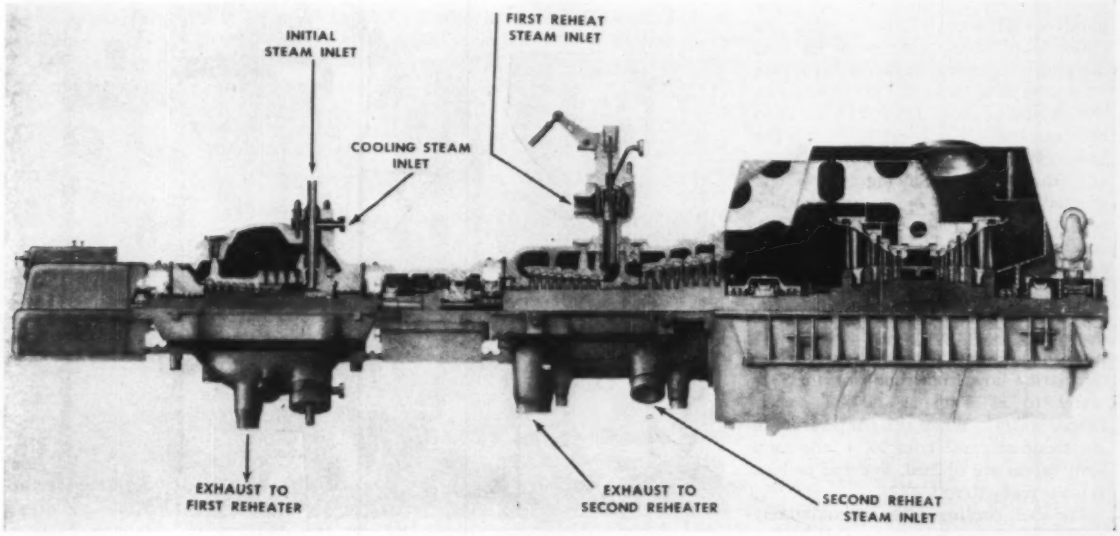
**First Commercial Supercritical Pressure Steam Turbine Generator for the Philo Plant,** by Charles W. Elston, Mem. ASME, and Raymond Sheppard, Mem. ASME, General Electric Company, Schenectady, N. Y. 1955 ASME Diamond Jubilee Annual Meeting paper No. 55—A-159 (multilithographed; to be published in Trans. ASME; available to Oct. 1, 1956).

From the designer's point of view the basic approach has been to consider the Philo turbine as a large developmental unit. In some instances, maximum rotor temperature conditions, for example, more severe than necessary were accepted in order to obtain engineering knowledge applicable to even further advances in the future. Operation of this prototype turbine will provide experience with new approaches to the problems of higher pressures and temperatures.

The authors described the steam flow




**Quarter section of entire General Electric Company 125,000-kw 3600-rpm supercritical pressure steam turbine-generator unit**

through the turbine in the following terms:

1 Steam cooling—accomplished by surrounding all austenitic parts inside the turbine with a thin thermal insulating metallic liner and circulating cooling steam at almost full pressure between this liner and the more massive ferritic sections which are maintained at lower temperature and which carry the main portion of the pressure load. The resulting small pressure load allows the use of thin-walled austenitic nozzle boxes and steam inlets with low-temperature gradients and reduced susceptibility to distortion.

2 Individual control-valve bodies of small diameter and consequently thinner walls.

3 Multiple steam pipes—the number of main steam pipes from the boiler is increased to four with individual turbine stop valves placed in each line permitting small valve bodies and pipe of reduced wall thickness.

4 Simple throttling control with full 360-deg arc admission to the first-stage nozzle.

Steam from the boiler reaches the turbine through four separate main steam pipes. Each main steam line has a separate stop valve and a separate control valve located external to the turbine and just below the turbine-room floor. The four control valves are operated by their individual operating cylinders under the control of a conventional starting handwheel and speed governor, and an initial pressure regulator.

When starting the cold boiler, the stop valves are closed. The boiler feed pump builds up full water pressure against the closed stop valves, and one or more of the multiple-pressure reducing valves are opened so as to throttle 4500 lb water in the amount of about 225,000 lb per hr to the deaerator. Fire is established in the boiler, the temperature is slowly raised, and the pressure-reducing valves are gradually opened by means of a pressure regulator so as to maintain substantially constant flow through the boiler and recirculating system. The steam is desuperheated after throttling through the reducing valves before entering the deaerator. The pressure-reducing valves must handle the 225,000 lb per hr recirculation flow from conditions of 60 F water to as high as 1150 F superheated steam. When the temperature of the steam reaches about 900 F, the main stop valves are opened, and the turbine is made ready to roll.

For shell cooling only, approximately 60,000 lb per hr of steam at full load is metered through orifices at the four main steam inlet flanges and is desuperheated under control of a temperature-sensing element so as to supply steam at 960 F through four entry points at the inlet flanges to the high-pressure section. With rotor cooling, the system is modified and the total cooling steam flow is increased to 100,000 lb per hr by enlarging the orifices. Leakage control is employed at both the admission and discharge sides of the buckets to minimize the mixing of rotor cooling steam with the main flow in the steam path.

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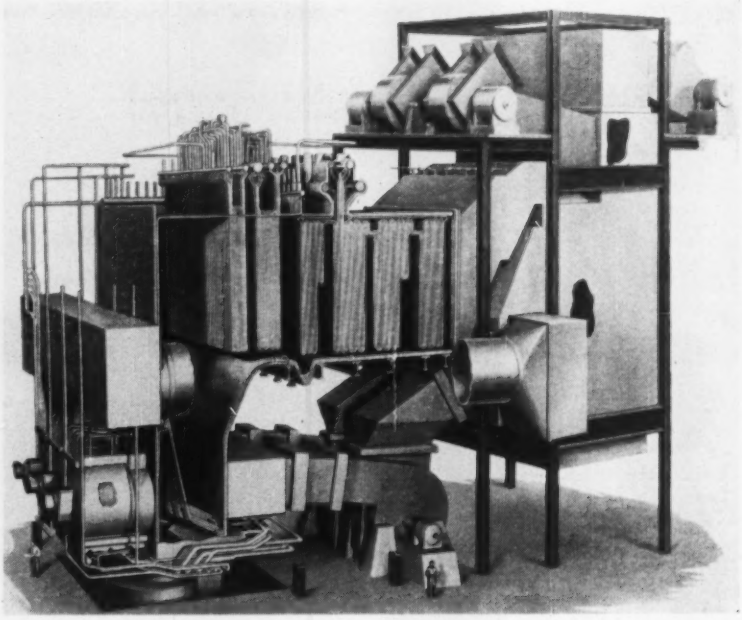
**First Commercial Supercritical Pressure Steam Generator for Philo Plant,** by Will H. Rowand, Mem. ASME, and A. Milton Frendberg, The Babcock & Wilcox Company, New York, N. Y. 1955 ASME Diamond Jubilee Annual Meeting paper No. 55—A-135 (multilithographed; to be published in Trans. ASME; available to Oct. 1, 1956).

In discussion design consideration the authors stated that of the 985 Btu added to each pound of the fluid in the high-pressure part of this unit, approximately 235 Btu are added to raise the feedwater from 525 F to the critical temperature, 705 F, and approximately 750 Btu are added to superheat the steam above this point. This compares to approximately 705 Btu to generate steam and 370 Btu to superheat the steam in a 2000-psi, 1050 F cycle with 450 F feedwater.

With this relatively small amount of heat to be added to the fluid as water, there comes the choice of arranging the circuits either so some of this heat is absorbed by the water in economizer surface or so all of it is absorbed by the water in furnace high-heat-input area. The latter condition was chosen because it gives some relief in the alloy requirements for the furnace tubes. However, it leaves the problem of getting surface equivalent to economizer surface with low enough receiving temperature efficiently to cool the gas below 800 F entering the air heater.

To accomplish this the primary superheater with a fluid-inlet temperature of 700 F is located on one side of the rear part of the convection pass with the low-pressure reheater having an inlet steam temperature of 630 F on the other side.

Design of supercritical pressure units is made more difficult because of the meager amount of published heat-transfer data for supercritical conditions. The authors pointed out that very limited data had previously been obtained above the critical pressure but with steam flowing in an annular space and at much lower Reynolds numbers than used in the universal pressure steam generator. Therefore an electrically heated test section was installed at the discharge of the pilot unit where fluid could be supplied at temperatures from 220 to



**Cross section of The Babcock & Wilcox Company supercritical pressure steam generator for Philo Plant**

1000 F at pressures up to 5000 psi in order to secure heat-transfer data for use in the design of the Philo unit. This test section consisted of a horizontal 6-ft-long section of Type 304 tubing, 0.300 in. ID and 0.540 in. OD. Thermocouple wells were installed at each end of the tube and a pressure gage connected to a point slightly upstream of the test section. Power was applied to the tube from three 40-kva transformers.

Data were obtained at various flow rates, temperatures, and pressures at heat fluxes from 150,000 to 600,000 Btu per sq ft per hr based on inside diameter of the tube. Film conductance proved to be higher than those based on a McAdams correlation particularly in the temperature range of 800 F to 1000 F. The Philo unit was designed on the basis of the McAdams correlation, leaving the difference between this and the test data as "safety factor."

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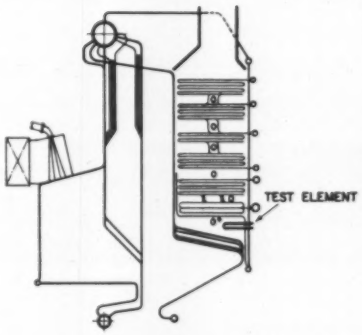
**Experimental Superheater for Steam at 2000 PSI and 1250 F—Report After 14,281 Hours of Operation,** by J. Hoke and F. Eberle, The Babcock & Wilcox Company, Alliance, Ohio. 1955 ASME Diamond Jubilee Annual Meeting paper No. **55—A-102** (multilithographed; to be published in Trans. ASME; available to Oct. 1, 1956).

To OBTAIN a practical and long-time demonstration of the suitability of certain new alloys, developed during and after World War II, for higher steam temperatures, a superheater test element was constructed and installed in an operating boiler at Twin Branch Plant, receiving steam at 2000 psi, 950 F, and discharging 1250 F steam at the outlet. Field operation began in March, 1950. The test element was finally removed from service in May, 1954, because changes in operating schedule reduced the rate of accumulation of service time and prevented the effective continuation of the test. The finding when this test element was removed and examined supplied the data for this paper.

At the time of removal the element has accumulated 14,281 hr of operating service of which 50 per cent had been with steam-outlet temperatures in excess of 1200 F, 31.5 per cent in the temperature range of 1100 to 1200 F and the remainder of the time at temperatures below 1100 F. During the same period (due to customary banked periods at night and week-end outages) the element also had been subjected to 828 temperature cycles of which 332 included temperatures below saturation when the steam was shut off.

Upon removal, the element was returned to the laboratory for a complete




**Location of superheater test element in boiler setting**

metallurgical investigation of the various tube materials and weldments. This investigation has included complete metallographic examinations of the tube materials and weldments, particularly with respect to the extent of external and internal oxidation and microstructural changes, and mechanical testing of tube materials and weldments such as room and elevated temperature (1350 F) tensile and impact tests, hardness determinations, flaring tests, and side bend tests of weldments. Records had been made periodically during the test period of any changes in external dimensions of the tubes. Stress-rupture testing of the tube materials and weldments has been initiated, but owing to the long-range nature of these tests, conclusive results are not yet available. This study of the stress-rupture properties will be reported later. Steam-oxidation tests on conventional superheater materials, conducted with cylindrical specimens shrink-fitted on the core rods of the test element at locations of increasing steam temperatures, likewise will be reported at a later date.

The final examination indicated that no serious deterioration of the essential properties has occurred in this pulverized coal-fired unit. The property most notably affected was impact strength but, with the possible exception of Timken 16-25-6, there appears to be adequate shock resistance remaining for superheater service, particularly at elevated temperatures. Changes in properties were most rapid during the first 6950 hr of service followed by a lower rate of change thereafter. The various weld deposits, particularly Armco 17-14 CuMo, had quite low impact resistance after service.

The oxidation resistance of all alloys appears to be adequate for the service for which they were employed. The investigation revealed also that the non-stabilized alloys 304 and 316 suffered no intergranular attack.

The performance of the experimental superheater and the behavior of the alloys of which it was constructed indicate that materials are available for use in superheaters for high-pressure steam up to 1250 F.

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**Evaluation of the Prototype Unit for the ASME High-Temperature Steam Generation Investigation,** by Bela Ronay, W. E. Clautice, U. S. Naval Engineering Experiment Station, Annapolis, Md., and W. F. Erskine, Research Committee on High Temperature Steam Generation, New York, N. Y. 1955 ASME Diamond Jubilee Annual Meeting paper No. **55—A-63** (multilithographed; available to Oct. 1, 1956).

THE subject of this paper is the evaluation of materials as superheater tubing for the temperature range of 1100 to 1500 F. One phase of this project concerns exposing tubes made of 17 different alloys to steam flow at 2000 psi and at various temperatures within the above given range. The project is financed by contributions from users and manufacturers of high-temperature steam generating equipment. The Navy Department's contribution is the design and fabrication of the equipment for exposing the special tubes to steam flow during a test programmed to last three years.

The report presents the test of the prototype portion of the final test equipment. This prototype was built to evaluate the design features of the various components and the reliability of the automatic control devices intended to serve the final installation. This unit was designed and built at the U. S. Naval Engineering Experiment Station, Annapolis, Md. The final installation will contain five such units as the prototype—all operating in series. Fabrication of the entire plant is under way and scheduled for completion in February, 1956.

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**Factors Influencing the Dynamic Behavior of Tall Stacks Under the Action of Wind,** by M. S. Ozker, Mem. ASME, and J. O. Smith, The Detroit Edison Co., Detroit, Mich. 1955 ASME Diamond Jubilee Annual Meeting paper No. 55—A-69 (in type; to be published in Trans. ASME; available to Oct. 1, 1956).

THIS paper sets forth what is believed to be a new concept of the dynamic response of tall stacks to wind action, in that the wind-induced vibrations of a stack are classified as "self-excited" rather than "forced." Information presented is pertinent to the design of structurally sound steel stacks, and includes

experimentally determined structural damping characteristics of welded, gunite-lined and riveted, bricklined steel stacks. Also presented is a realistic value of the often disputed "lateral force coefficient $C_L$," as determined from observations on actual stacks.

## Hydraulics

**Surge-Wave Velocity—Concrete Pressure Pipe,** by H. F. Kennison, Assoc. Mem. ASME, Lock Joint Pipe Line, East Orange, N. J. 1955 ASME Diamond Jubilee Annual Meeting paper No. 55—A-75 (in type; to be published in Trans. ASME; available to Oct. 1, 1956).

THE velocity of the surge wave is fundamental in the solution of water-hammer problems. To date little, if any, information has been published on this subject relating to reinforced and prestressed concrete pressure pipe. Unlike steel and cast-iron pipe, the surge-wave velocity for concrete pressure pipe is not a constant but varies with the maximum water-hammer pressure. This relationship is outlined together with test results from several existing concrete pressure pipe lines.

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**Water-Column Separation in Pump-Discharge Lines,** by R. T. Richards, Ebasco Services Inc., New York, N. Y. 1955 ASME Diamond Jubilee Annual Meeting paper No. 55—A-74 (in type; to be published in Trans. ASME; available to Oct. 1, 1956).

WATER-COLUMN separation is a common, but rarely discussed, surge phenomenon which may result in serious damage to water-pumping plants. This paper briefly describes the nature of water-column separation, the physical factors which bring it about, and the equipment effective in controlling it. The discussion is illustrated by field test data taken from typical water-pumping plants associated with the cooling-water supply for steam-electric stations.

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**Thermodynamic Aspects of Cavitation in Centrifugal Pumps,** by H. A. Stahl and A. J. Stepanoff, Mem. ASME, Ingersoll Rand Company, Phillipsburg, N. J. 1955 ASME Diamond Jubilee Annual Meeting paper No. 55—A-136 (multilithographed; to be published in Trans. ASME; available to Oct. 1, 1956).

EXISTING knowledge on the control and avoidance of cavitation in pumps has been entirely experimental and statistical in nature, according to this paper. Most of the data have been gained on tests for which cold water was the medium. Extension of these data to other operating conditions and other sizes are made by means of the similarity law. Only the dynamic aspects of the machine are taken into account and the assumption is that the data gained from cold-water tests apply in all cases. However, there is evidence that thermodynamic properties of liquids are additional variables which can result in deviations from the dynamic laws of similarity. The purpose of this paper was to elaborate on the thermodynamic aspects of cavitation.

## Water Hammer

**Hydraulic Transients in Centrifugal-Pump Systems,** by C. P. Kittredge, Princeton, N. J. 1955 ASME Diamond Jubilee Annual Meeting paper No. 55—A-72 (in type; to be published in Trans. ASME; available to Oct. 1, 1956).

DIFFERENTIAL equations of motion for (*a*) the rotating parts of the pump and prime mover, and (*b*) the fluid in the pipes are derived. Methods of integrating the equations are discussed for the case of an assumed rigid fluid column and for the elastic fluid column.

A hitherto unpublished solution for the elastic-column problem is described. Complete characteristics diagrams for several pumps are given. Solutions by different methods are compared and examples for actual installations shown.

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**Water-Hammer Calculations and Test Results—Owens Gorge Power Plant Penstocks,** by A. E. Bratfisch and K. O. Cartwright, Mem. ASME, Dept. of Water & Power, Los Angeles, Calif. 1955 ASME Diamond Jubilee Annual Meeting paper No. 55—A-71 (in type; to be published in Trans. ASME; available to Oct. 1, 1956).

WATER-HAMMER calculations were made for the three penstocks of the Owens Gorge Power Plants to determine proper governor and relief-valve time settings. Test results show good agreement with the calculations. Computing methods, complete test results, and an analysis of these results are included in this paper. A brief discussion of the operation of the surge chambers for these plants is also included.

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**Solutions of Transient Heat-Transfer Problems by the Resistance-Network Analog Method,** by G. Liebmann, Aldermaston, Berkshire, England. 1955 ASME Diamond Jubilee Annual Meeting paper No. 55—A-61 (in type; to be published in Trans. ASME; available to Oct. 1, 1956).

THE resistance-network analog method for the solution of transient heat-conduction problems, described in an earlier paper, is extended to problems involving heat transfer across a surface, or generation or absorption of heat in the interior of the system. The flexibility of the method and its "stability" are retained in this extension. The method also can be applied to latent heat problems. Several examples are discussed which illustrate the technique.

## Metal Processing

**An Analysis of the Orthogonal Boring Operation,** by Bernard W. Shaffer, Mem. ASME, New York University, New York, N. Y. 1955 ASME Diamond Jubilee Annual Meeting paper No. 55—A-67 (in type; to be published in Trans. ASME; available to Oct. 1, 1956).

THE shear line, during the orthogonal boring operation, was found to be a circular arc extending from the tip of the tool and separating the uncut workpiece from the newly formed chip. Its orientation with respect to the cutting tool was prescribed in this paper by the condition that the element within the chip, at the base of the tool, did not exceed the yield point of the material as the cutting force was transferred from the tool to the shear line. Under these conditions, a shear-angle relationship, an expression for machining force, and an expression for the chip-thickness ratio were derived for orthogonal boring.

It was found, by examining these equations, that as the internal radius of the workpiece increases, the shear angle increases and the machining force decreases, whenever a given depth of cut is taken under identical machining conditions. At the same time, the chip-thickness ratio increases for small friction angles and decreases for large friction angles. As the internal radius of the workpiece increases, the analytical expressions approach the corresponding equations found for the orthogonal planing operation.

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**Residual Stresses in Cold-Extruded Aluminum,** by J. Frisch, Assoc. Mem. ASME, and E. G. Thomsen, Mem. ASME, University of California. 1955 ASME Diamond Jubilee Annual Meeting paper No. 55—A-27 (in type; to be published in Trans. ASME; available to Oct. 1, 1956).

A 1.5-IN-DIAM cylindrical bar was extruded at room temperature from an 1100-0 (2S-0) aluminum 4.3-in-diam billet. Residual compressive stresses in the longitudinal direction were found to exist on the surface of the extruded bar.

These stresses, as determined from the axially relaxed stresses in the billet during extruding, were found to be in qualitative agreement with the experimentally determined residual stresses as found by Sachs' boring-out method.

The severeness of work hardening at the edge of the die, found from the hardness pattern on the sectioned partially extruded billet, was in close agreement with the distribution of natural strains obtained under the same conditions of extrusion.

## Applied Mechanics

**Studies on Plastic Flow of Anisotropic Metals,** by L. W. Hu, University Park, Pa. 1955 ASME Diamond Jubilee Annual Meeting paper No. **55—A-79** (in type; to be published in the *Journal of Applied Mechanics;* available to Oct. 1, 1956).

THIS investigation deals with a study of the plastic behavior of anisotropic metals. By extending Hill's theory of plastic flow of anisotropic metals, plastic stress-strain relations for anisotropic materials with strain hardening are developed.

Applications of these relations are also made to plane-stress and plane-strain problems with anisotropy. The effect of anisotropy on the stress distribution and on the pressure to produce yielding in a thick-walled cylinder under internal pressure is discussed. The influence of anisotropy on the interpretation of conventional biaxial tension-tension and tension-torsion tests is also considered in this study.

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**Analysis of Creep in Rotating Disks Based on the Tresca Criterion and Associated Flow Rule,** by A. M. Wahl, East Pittsburgh, Pa. 1955 ASME Diamond Jubilee Annual Meeting paper No. **55—A-46** (in type; to be published in the *Journal of Applied Mechanics;* available to Oct. 1, 1956).

AN analysis of creep deformations in rotating disks based on the Tresca criterion and the associated flow rule is presented. Assuming steady-state creep conditions and a creep rate equal to a function of stress times a function of time, the method is applied to the following cases: (*a*) Disk with constant thickness and constant temperature, (*b*) disk with variable thickness and constant temperature, and (*c*) disk with variable thickness and variable temperature. In many cases, the equations can be expressed in closed form. Comparison is made with test results on rotating disks at elevated temperature as reported in a previous paper.

Based on certain stress-creep-rate relations, the method is also applied to the problem of calculating the transient change in stress when the stress distribution changes from an initial to a steady-state condition during the starting period. It is suggested that the simplification effected by the use of these methods may be of value for design purposes pending the development of more accurate methods based on test results.

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**Bending and Torsion of Circular Cylinder Cantilever Beams of Cylindrically Aeolotropic Material,** by W. S. Ericksen, Wright-Patterson Air Force Base, Ohio. 1955 ASME Diamond Jubilee Annual Meeting paper No. **55—A-41** (in type; to be published in the *Journal of Applied Mechanics;* available to October 1, 1956).

THIS paper deals with the problem of determining the components of stress and displacement associated with the flexure and torsion of a cantilever beam in the form of a hollow circular cylinder of cylindrically aeolotropic material. A solution satisfying the conditions of the theory of elasticity is obtained by the semi-inverse method of Saint Venant.

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**Buckling of Simply Supported Plates Tapered in Planform,** by Bertram Klein, North American Aviation, Inc., Los Angeles, Calif. 1955 ASME Diamond Jubilee Annual Meeting paper No. **55—A-39** (in type; to be published in the *Journal of Applied Mechanics;* available to October 1, 1956).

DESIGN curves are presented for determining the elastic buckling loads of simply supported flat plates of isosceles trapezoidal planform and loaded in compression along the parallel edges. Shear loads are assumed to act along the sloping edges so that any ratio of axial loads may act along the parallel edges of the given plate. Isosceles triangular plates are included as a special limiting case, and the range of the values of the various geometric and load parameters presented in the curves is considered large enough to cover practically all conditions of the type treated which are encountered in practice.

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**Effect of an Acoustic Medium on the Dynamic Buckling of Plates,** by F. L. Dimaggio, Columbia University, New York, N. Y. 1955 ASME Diamond Jubilee Annual Meeting paper No. **55—A-35** (in type; to be published in the *Journal of Applied Mechanics;* available to October 1, 1956).

THE effect of a surrounding fluid on the dynamic buckling of an elastic plate under suddenly applied compressive stresses in its middle plane is studied. Assuming an infinite plate supported at regular intervals and a semi-infinite acoustic medium, exact and approximate solutions are obtained. By a numerical example, it is shown that for steel plates in water, with dimensions usually encountered in ship structures, the compressibility of water can be neglected.

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**Pretwisted Beams and Columns,** by John Zickel, Schenectady, N. Y. 1955 ASME Diamond Jubilee Annual Meeting paper No. **55—A-28** (in type; to be published in the *Journal of Applied Mechanics;* available to October 1, 1956).

A THEORY is developed for the behavior of pretwisted structural members of thin-walled section with slight initial bending. The stresses are at first determined along and perpendicular to the fibers and are then transformed to stresses in the cross section and along the axis. Although the development is perfectly general the integrations are only indicated for doubly symmetric sections. The buckling of doubly symmetric columns which are initially straight but are pretwisted at a constant rate is treated in detail.

Results show that columns of decidedly unequal principal moments of inertia can be strengthened up to 90 per cent, but columns of equal moments of inertia are weakened by initial twist. In analogy to the Euler load of the buckling theory for straight, untwisted columns, a reduced Euler load is defined. The buckling load is the product of this reduced Euler load and a stiffening factor.

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**On the Wake Energy of Moving Cascades,** by N. H. Kemp, United Aircraft Corporation, East Hartford, Conn., and W. R. Sears, Cornell University, Ithaca, N. Y. 1955 ASME Diamond Jubilee Annual Meeting paper No. **55—A-33** (in type; to be published in the *Journal of Applied Mechanics;* available to October 1, 1956.

THE rate of transfer of energy to the vortex-wake pattern is calculated for isolated thin airfoils and cascades of thin airfoils in unsteady flow. This part of the work parallels earlier investigations by Garrick and Keller.

Application is made to the elementary two-row stages treated in an investigation of the induction effects due to relative motion of the blade rows.

Results show that the energy transferred to the wake pattern is a small fraction of the work absorbed by the rotor. Cross-induced contributions for a two-row stage may be negative but are small. By far the greatest contribution to the wake energy is that due to the

circulation fluctuations induced in a blade row by the relative motion of the adjacent downstream row.

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**On the Torsion of Rectangular Sandwich Plates,** by Paul Seide, The Ramo-Wooldridge Corporation, Los Angeles, Calif. 1955 ASME Diamond Jubilee Annual Meeting paper No. **55—A-40** (in type; to be published in the *Journal of Applied Mechanics;* available to October 1, 1956).

THE torsional rigidity of rectangular sandwich plates of constant thickness is calculated, with cross sections assumed free to warp. The faces are isotropic and of equal thickness while the core may be orthotropic, the axes of orthotropy coinciding with co-ordinate axes of the structure.

The computed torsional rigidity of sandwich plates of moderate width-thickness ratio can be quite unconservative if the twisting stiffness constant of sandwich-plate theory is used, since the lower limit of the width-thickness ratio of a sandwich plate for it to be considered infinitely wide is somewhat greater than the value of 10 found for isotropic plates. For a sandwich beam with a particular balsa core, this degree of unconservatism was found to be about 61 per cent when the width-core depth ratio was 10 and the face-core thickness ratio was 10.

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**On Some Problems in Bending of Thick Circular Plates on an Elastic Foundation,** by Daniel Frederick, Virginia Polytechnic Institute, Blacksburg, Va. 1955 ASME Diamond Jubilee Annual Meeting paper No. **55—A-36** (in type; to be published in the *Journal of Applied Mechanics;* available to October 1, 1956).

THE thick-plate theory developed by E. Reissner which includes the effects of shear deformation and normal stress can be used to solve problems in the bending of circular plates on an elastic foundation. For symmetric and antisymmetric problems the solutions can be expressed in terms of Bessel functions of zero and first order with a complex argument. Since these have been partially tabulated numerical calculations can be conveniently carried out for certain cases.

Two specific examples have been considered in this paper and certain numerical results are presented graphically. Since these have been compared with the corresponding values as given by the classical theory, the value of a thickness-length parameter at which the effects of shear deformation and normal pressure must be taken into account can be determined from the figures.

Finally, the solutions to other problems in plate theory may be obtained by using the solutions given in this paper.

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**Stiffness of Curved Circular Tubes With Internal Pressure,** by P. G. Kafka and M. B. Dunn, Boeing Airplane Company, Seattle, Wash. 1955 ASME Diamond Jubilee Annual Meeting paper No. **55—A-32** (in type; to be published in the *Journal of Applied Mechanics;* available to October 1, 1956).

A METHOD is presented for computing the flexibility factor for plane pipe lines with internal-pressure effects considered.

Formulas for the first and second approximation to both the flexibility and the stress-intensification factors are given. Comparisons of the second approximations with experimental results are also made.

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**Effect of Hub Radius on the Vibrations of a Uniform Bar,** by W. E. Boyce, Brown University, Providence, R. I. 1955 ASME Diamond Jubilee Annual Meeting paper No. **55—A-44** (in type; to be published in the *Journal of Applied Mechanics;* available to October 1, 1956).

METHODS are discussed for obtaining upper and lower bounds on the frequencies of a uniform beam, rotating at a constant speed about an axis at one end, and vibrating transversely to the plane of rotation.

Previous results are extended to include the case of a nonzero hub radius. Bounds on the first two frequencies are given for several ratios of hub radius to beam length. These show that the frequencies depend almost linearly on the hub radius for various rotational speeds.

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**Momentum Diffusion From a Slot Jet Into a Moving Secondary,** by A. S. Weinstein, J. F. Osterle, and W. Forstall, Pittsburgh, Pa. 1955 ASME Diamond Jubilee Annual Meeting paper No. **55—A-60** (in type; to be published in the *Journal of Applied Mechanics;* available to Oct. 1, 1956).

RESULTS are presented for an experimental, impact-tube study of the diffusion of momentum for the isothermal, incompressible, turbulent mixing of a slot jet issuing into a slower moving-secondary region. The symmetric spread of the jet into a uniformly flowing secondary stream of low initial turbulence is well correlated by phenomenological expressions based on assumptions suggested by the Engineering Experiment Station of the University of Illinois and extended in this paper to include the case of the slot jet issuing into a moving secondary.

The single parameter upon which this correlation is based, the spreading coefficient, is shown to have an interesting interpretation in terms of the diffusion of a stream of fluid "particles" into uniformly flowing fields of homogeneous isotropic turbulence.

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**Some Dynamic Properties of Oil-Film Journal Bearings With Reference to the Unbalance Vibration of Rotors,** by A. C. Hagg, Mem. ASME, and G. O. Sankey, Westinghouse Research Laboratories, East Pittsburgh, Pa. 1955 ASME Diamond Jubilee Annual Meeting paper No. **55—A-45** (in type; to be published in the *Journal of Applied Mechanics;* available to October 1, 1956).

SOME dynamic properties of oil films have been determined experimentally and their significance in the problem of unbalance vibration and critical speeds of rotor systems is illustrated by an example.

It is shown that oil films have an important role in the unbalance-vibration behavior of rotor systems, particularly the vibration magnification at resonance.

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**The Stress Distribution in a Strip Loaded in Tension by Means of a Central Pin,** by P. S. Theocaris, Athens National Technical University, Athens, Greece. 1955 ASME Diamond Jubilee Annual Meeting paper No. **55—A-34** (in type; to be published in the *Journal of Applied Mechanics;* available to October 1, 1956).

THE purpose of this paper is to give an exact solution for the stress distribution resulting from loading a perforated strip in tension through a rigid pin filling the hole. The strip is regarded as of an infinite length and having a single axial hole. Stress distributions are found by an alternating approximation method and the stresses are tabulated in the form of stress-concentration factors for different values of diameter of the hole. The influence of size of the hole on the stress concentration in the strip is investigated and the optimum diameter of the hole is evaluated.

## Heat Transfer

**Turbulent Flow and Heat Transfer on a Flat Plate at High Mach Number With Variable Fluid Properties,** by R. G. Deissler, Assoc. Mem. ASME, and A. L. Loeffler, Jr., Lewis Flight Propulsion Laboratory, NACA, Cleveland, Ohio. 1955 ASME Diamond Jubilee Annual Meeting paper No. **55—A-133** (multilithographed; available to Oct. 1, 1956).

A PREVIOUS analysis for turbulent heat transfer and flow with variable fluid properties in smooth passages is extended to the case of flow over a flat plate at high Mach numbers. Velocity and tem-

perature distributions are calculated for a boundary layer in which the effects of both frictional heating and external heat transfer are appreciable. The density, viscosity, and thermal conductivity of the air are considered variable with temperature. Skin friction and heat-transfer coefficients are calculated and compared with the incompressible values. The relation between boundary-layer thickness and distance along the plate is obtained for various Mach numbers.

The analytical results are compared with the available experimental data.

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**Laminar Free-Convection Heat Transfer From the Outer Surface of a Vertical Circular Cylinder,** by E. M. Sparrow and J. L. Gregg, National Advisory Committee for Aeronautics. 1955 ASME Diamond Jubilee Annual Meeting paper No. **55—A-25** (in type; to be published in Trans. ASME; available to Oct. 1, 1956).

A SOLUTION of the laminar boundary-layer equations has been obtained for free convection from the outer surface of a vertical cylinder. The temperature of the cylinder surface was taken to be uniform. Heat-transfer results have been found for Prandtl numbers of 0.72 and 1 (i.e., for gases) and are presented on graphs. The Nusselt numbers for the cylinder were higher than those for the flat plate. Also, the deviation of the cylinder Nusselt numbers from those for the flat plate was greater for Prandtl number of 0.72 than for Prantdl number of 1.

A quantitative criterion was established for determining the conditions under which the heat transfer from a cylinder could be calculated with sufficient accuracy using the flat-plate results. An analysis based on replacing the free-convection problem by a problem in pure conduction through a fictitious layer of stagnant fluid gave good agreement with the boundary-layer solution.

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**Graphical Methods for the Temperature Response of Bodies in a Varying Temperature Medium,** by F. Landis, Assoc. Mem. ASME, New York University, New York, N. Y., and J. O. Tearnen, Assoc. Mem. ASME, Convair, San Diego, Calif. 1955 ASME Diamond Jubilee Annual Meeting paper No. **55—A-141** (multilithographed; available to Oct. 1, 1956).

IN annealing and curing processes the temperature response of a body submerged in a medium with time-varying temperatures may be required. Previous solutions, presented graphically as Hottel, Gurney-Lurie, Heisler charts, and the like, have all been limited to a constant-temperature medium.

This paper extends the use of these charts to permit a varying temperature medium, provided that the temperature variation can be represented by a series of step increments.

The mathematical development is given in detail for the large slab, and an extension of the method to cylinders, rectangular parallelepipeds, and spheres is indicated. An illustrative sample calculation is worked out which shows the use of the Heisler charts for stepwise variations of the medium temperature.

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**The Air-Cooled Electronic Chassis,** by M. Mark, Mem. ASME, and M. Stephenson, Assoc. Mem. ASME, Raytheon Manufacturing Company, Newton, Mass. 1955 ASME Diamond Jubilee Annual Meeting paper No. **55—A-55** (multilithographed; available to Oct. 1, 1956).

A METHOD of cooling certain types of electronic equipment incorporates in the chassis a simple plate-fin heat exchanger, sometimes called a cold plate or cooled chassis. To determine which internal configuration gives most efficient heat transfer, equations for cold plates are developed, and fin density, height, and thickness varied. The effect on required power, coolant flow rate, and pressure drop is noted, and some conclusions drawn as to optimum design.

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**High-Speed Guarded-Hot-Plate Apparatus for Thermal Conductivity of Thermal Insulation,** by E. V. Somers, Westinghouse Electric Corporation, East Pittsburgh, Pa. 1955 ASME Diamond Jubilee Annual Meeting paper No. **55—A-129** (multilithographed; to be published in Trans. ASME; available to Oct. 1, 1956).

A LONG-DESIRED improvement in the field of physical testing has been an instrument which will measure the thermal conductivity of a thermal insulating material in a time interval of several minutes. The guarded-hot-plate method, with apparatus described in past literature, has required testing-time intervals varying from many hours to several days. Recent improvements have shortened the testing-time interval to as small as 6 hr, by employing transient power to the heaters under automatic control at values in excess of the eventually attained steady-state value.

A second improvement in the testing time is that to be obtained by using a heater plate of very low thermal capacity, since the long transient-time interval is due to the large amount of heat required to heat the heater plate to its steady-state temperature compared to the power applied to the heaters.

This paper describes the construction of a low thermal-capacity heater plate and its use with a variable transient power to both heaters, controlled by commercially available power controllers. The testing-time interval has been reduced to 10 to 15 min for samples with $k$-factors about 0.2 Btu in./hr sq ft deg F.

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**Experimental Study of the Temperature Distribution in Plates During Arc Welding,** by R. J. Grosh and G. A. Hawkins, Mem. ASME, Purdue University, West Lafayette, Ind. 1955 ASME Diamond Jubilee Annual Meeting paper No. **55—A-26** (multilithographed; available to Oct. 1, 1956).

THIS paper describes an experimental investigation performed to corroborate results of an analytical study of the temperature distribution during welding of plates.

Analytical results were obtained for one, two, and three-dimensional heat conduction from a moving plane, line, and point energy source where the thermal properties of the solid are specific functions of temperature.

The experiment consisted of welding thin stainless-steel plates, and was conducted to test the reliability of the two-dimensional results.

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**The New Zealand Thermal Area and Its Development for Power Production,** by C. J. Banwell, Dominion Physical Laboratory, Lower Hutt, New Zealand. 1955 ASME Diamond Jubilee Annual Meeting paper No. **55—A-58** (multilithographed; to be published in Trans. ASME; available to Oct. 1, 1956).

THE main thermal area in the North Island of New Zealand is described, and a short account given of its geological history and of its relation to the Pacific seismic and volcanic belt.

The prospecting and development drilling program, commenced at Wairakei in 1950, is presented. Temperature information from the drill holes has been used to prepare several temperature sections through the development area. Wairakei drill holes have nearly all tapped a mixture of steam and water, with a mean enthalpy for all producing holes of 450 Btu per lb.

In the month of November, 1954, 16 producing holes were discharging a total mass of 1.38 million lb per hr, the steam fraction of which, at 70 psi wellhead pressure, represents a generated power output of 20,000 kw. The total esti-

mated natural heat output of the Wairakei area is equivalent to approximately 100,000 kw of generated power.

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**Convection Phenomena in Fluids Heated From Below,** by S. Ostrach, Lewis Flight Propulsion Laboratory, NACA, Cleveland, Ohio. 1955 ASME Diamond Jubilee Annual Meeting paper No. **55—A-88** (multilithographed; available to Oct. 1, 1956).

A REVIEW of nearly a century's research on the effects of heating a fluid from below in a body-force field reveals many unusual aspects of the resulting flow which had previously been of meteorological interest only. For horizontal fluid layers, the flow was found to depend on a single parameter (the Rayleigh number). Below certain critical values of the Rayleigh number the configuration is in stable equilibrium; for Rayleigh numbers exceeding the critical either columnar or cellular flows occur with increased transfer rates.

It is pointed out that configurations with heating from below are also encountered in present-day problems in various fields. A recent experiment and an analysis of fluids heated from below in a vertical enclosure (which more closely simulates current configurations) are discussed. There is an apparent correlation between the previous research for meterological purposes and new fluid mechanics and heat-transfer problems of current interest.

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**The Transfer of Heat and Momentum in a Turbulent Stream of Mercury,** by H. E. Brown, B. H. Amstead, Assoc. Mem. ASME, and B. E. Short, Fellow ASME, University of Texas, Austin, Texas. 1955 ASME Diamond Jubilee Annual Meeting paper No. **55—A-106** (multilithographed; available to Oct. 1, 1956).

RESULTS of an experimental determination of the transfer of heat and momentum in a stream of mercury flowing in the turbulent region in a water-cooled nickel pipe are reported in this paper. A range of Reynolds numbers from approximately 200,000 to 800,000 was involved.

Temperature and velocity profiles were measured for the stream and, from the data, values of the eddy diffusivity for heat transfer and for momentum transfer were calculated. The ratio of the eddy diffusivity for heat transfer to the eddy diffusivity for momentum transfer calculated from the data at the mean radius was between 0.7 for the lower Reynolds number and 0.9 for the higher Reynolds number. This ratio was essentially constant for the inner 80 per cent of the radius and dropped rapidly in the outer 20 per cent of the radius. The relative pipe roughness determined from pressure-drop data for isothermal runs on the apparatus was shown by the Moody chart to be about 0.00015. The heat-transfer coefficients are in good agreement with the Martinelli-Lyon relation for the same diffusivity ratios.

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**Mass-Transfer Cooling in a Laminar Boundary Layer With Constant Fluid Properties,** by J. P. Hartnett, Mem. ASME, and E. R. G. Eckert, Mem. ASME, University of Minnesota, Minneapolis, Minn. 1955 ASME Diamond Jubilee Annual Meeting paper No. **55—A-108** (multilithographed; to be published in Trans. ASME; available to Oct. 1, 1956).

MASS transfer or transpiration cooling offers great possibilities for maintaining tolerable surface temperatures on high-speed aircraft or on turbine blades.

This study is concerned with the prediction of heat transfer, skin friction, and required coolant flows for such transpiration-cooled surfaces. The solutions presented were collected in so far as possible from the literature, and were supplemented by new calculations where required for the case of the flat plate and plane stagnation flows.

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**Seal Leakage in the Rotary Regenerator and Its Effect on Rotary-Regenerator Design for Gas Turbines,** by D. B. Harper, Aluminum Company of Canada, Ltd., Montreal, Can. 1955 ASME Diamond Jubilee Annual Meeting paper No. **55—A-109** (multilithographed; to be published in Trans. ASME; available to Oct. 1, 1956).

THE rotary regenerator has been analyzed in detail with respect to its application in a gas-turbine cycle. This has shown that, even though a definite small leakage between high and low-pressure sides must exist, it will not detract from the size advantage of this type of heat exchanger.

An analysis and experimental investigation of seal leakage in the rotary regenerator has been described. The theoretical results are quite adequate for seal-design purposes. The method of reducing the displacement loss by cross-connecting ported seal shoes is shown and gives considerable promise.

A rotary regenerator has been sized for a specific gas-turbine-plant requirement. The effect of choice of pressure drop and leakage rate are shown by design-point curves. A suggested plant layout is presented to enable visualization of the space requirements of the rotary regenerator.

A general conclusion may be drawn that the best over-all rotary-regenerator arrangement will have a rotor containing the matrix and a system of rotating compartmented ducts leading out to small seal shoes. The seal shoes can be pressure-balanced by a diaphragm or piston which can be pressurized by a port in the seal shoe itself. The location of this port along the pressure gradient will depend on the seal area and piston area. This loading force should be just sufficient to keep the seal in close contact with the rotor compartments, but not to cause excess friction. If the seals act on opposite faces of a drum-type rotor, thermal expansion of the rotor will not result in great difficulties.

As such a rotor will contain large rotating volumes, a system of seal porting and cross-connection should be used to minimize leakage. This general arrangement with the matrix mounted in a number of separate compartments would facilitate provision for separate removal and replacement of matrix elements.

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**Cooling of Glass Molds,** by Rudolf L. Wille, Hermann Foettinger Institute, Technical University, West Berlin, Germany. 1955 ASME Diamond Jubilee Annual Meeting paper No. **55—A-65** (multilithographed; available to Oct. 1, 1956).

THE cooling of glass molds of bottle machines is conventionally done by blowing air over the outer surface of the mold. Experiments at the running machine proved that the air-jet energy can be lowered considerably when using "spines" on the surface of the mold.

Furthermore, the new system of "evaporation cooling" has been investigated in theory and in experiment. Dosed quantities of water drops are applied to locally concentrated "heat sinks" at the outer surface of the glass mold. It could be proved that periodical heat transfer to boiling water is an economical way of mold cooling. Finally, experiments are described studying the effect of liquid sodium in hollow molds.

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**Combined-Forced and Free-Laminar Heat Transfer in Vertical Tubes With Uniform Internal Heat Generation,** by T. M. Hallman, Assoc. Mem. ASME, Lewis Flight Propulsion Laboratory, NACA, Cleveland, Ohio. 1955 ASME Diamond Jubilee Annual Meeting paper No. **55—A-73** (multilithographed; available to Oct. 1, 1956).

FULLY developed velocity profiles, temperature profiles, mixed-mean-to-wall temperature differences, Nusselt numbers,

and pressure drops are predicted for combined-forced and free-laminar convective heat transfer in vertical round pipes. Uniform internal-heat generation within the fluid may or may not be present and a uniform heating or cooling at the tube wall is considered (including the case of the insulated wall).

A comparison is made between the analysis and the small amount of experimental data available in the literature.

## Availability List of Unpublished ASME Papers

A NUMBER of papers and reports were presented at ASME Meetings which were not preprinted or published. Manuscript copies of these papers are on file for reference purposes in the Engineering Societies Library, 29 West 39th St., New York 18, N. Y. Photostatic copies of these unpublished papers may be secured from the Library at the rate of 40 cents per page. The following papers recently have been placed on file in the Engineering Societies Library:

### 1955 Second Annual ASME-ASLE Lubrication Conference

Determination of Grease Consistency Using an Automatic Worker Viscometer, by H. J. Connors

Effect of Oxygen Concentration in Atmosphere on Oil Lubrication of High-Temperature Ball Bearings, by Z. N. Nemeth and W. J. Anderson

Studies of Formation and Behavior of an Extreme Pressure Film, by V. N. Borsoff and C. D. Wagner

### 1955 Joint ASME-AIME Fuels Conference

Navy Practice of Designing for Dual Fuel Firing in Shore-Station Steam Plants, by L. F. Deming

### 1955 ASME Diamond Jubilee Annual Meeting

Rubber Applications in Transportation—Past, Present, and Future, by H. H. Waters

Evaluation of Factors Affecting Heat Transfer in Furnaces, by M. Greyson, G. P. Mazie, J. W. Myers, R. C. Corey, and E. G. Graf

New Techniques in Metal-Cutting Research, by W. R. Backer and E. J. Krabacher.

## ASME Transactions

### for January, 1956

THE January, 1956, issue of the Transactions of the ASME (available at $1 per copy to ASME members; $1.50 to nonmembers) contains the following technical papers:

The Integration of Concepts in the Terminology of Measurement and Control, by H. L. Mason. (54—IRD-3)

Turbulence in a Tilting-Pad Thrust Bearing, by Stanley Abramovitz. (54—LUB-7)

Investigation of Translatory Fluid Whirl in Vertical Machines, by G. F. Boeker and B. Sternlicht. (54—LUB-3)

Oil-Film Whirl—An Investigation of Disturbances Due to Oil Films in Journal Bearings, by B. L. Newkirk and J. F. Lewis. (54—LUB-4)

Load Capacity and Time Relations for Squeeze Films, by F. R. Archibald. (54—A-50)

Quadratic Programming of Interdependent Activities for Optimum Performance, by L. E. Saline. (54—A-58)

Some Observations on Formal Models for Programming, by J. J. Slade, Jr. (54—A-241)

Theories on Bourdon Tubes, by F. B. Jennings. (54—A-168)

Sensitivity and Life Data on Bourdon Tubes, by H. L. Mason. (54—A-169)

Studies in Cold-Drawing—Part 3, Determination of Friction Coefficient, by H. Majors, Jr. (54—A-114)

Sulphur Dew-Point Corrosion in Exhaust Gases, by R. L. Coit. (55—S-34)

Water Tunnels for Hydraulic Investigations, by J. M. Robertson. (55—S-19)

An Extension of the Theory of Water Hammer, by R. Skalak. (55—S-18)

Design of Optimum Clearances in Positive-Displacement Pumps and Motors, by W. E. Wilson. (55—S-4)

Fundamentals of the Vibratory Rate Gyro, by J. B. Chatterton. (55—S-25)

Design Features, Operating Experience, and Performance of 100,000-Kw Reheat Installation at Potomac River Station, by L. W. Cadwallader and H. S. Frederick. (55—S-21)

An Approach to the Economic Problem of Matching Condenser Surface With Exhaust-Annulus Area, by W. A. Wilson and L. G. Malouf. (55—S-31)

Improving Airplane Handling Characteristics With Automatic Controls, by C. L. Muzzey. (55—IRD-3)

Disturbance-Response Feedback—A New Control Concept, by J. B. Reswick. (55—IRD-2)

Evaluation of the Nonlinear Kinetic Behavior of a Nuclear Power Reactor, by R. C. Howard. (55—IRD-8)

Aerothermodynamic Considerations Involved in Turbocharging Four and Two-Cycle Diesel Engines, by Rudolph Birmann. (55—OGP-10)

Fuels for U. S. Navy Gas Turbines, by H. F. King and H. V. Nutt. (55—OGP-8)

Effect of Size on the Inlet-System Dynamics in Four-Stroke, Single-Cylinder Engines, by D. H. Tsai. (55—OGP-3)

Ultrasonic Testing of Small-Diameter Tubing With Automatic Recording Equipment, by W. L. Fleischmann and H. A. F. Rocha. (55—S-23)

Heat Transfer to Turbulent Boundary Layers With Variable Free-Stream Velocity, by R. A. Seban and D. L. Doughty. (55—SA-68)

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Note: No digests are made of ASME papers published in full or condensed form in other sections of Mechanical Engineering.

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# Comments on Papers

## Including Letters From Readers on Miscellaneous Subjects

### Residual Stresses in Cold-Finished Steel Bars

#### Comment by L. P. Tarasov[1]

THE author's brief mention of grinding stresses[2] calls for a few comments to put this subject in the proper perspective. Although the available surface-grinding studies have shown that the residual grinding stresses in annealed steel are essentially tensile in nature, similar studies on hardened steel, but under a wider variety of conditions, have shown that the stresses can be tensile or compressive, or combinations of these, such as compressive at the surface and tensile immediately below.[3] Quite possibly, the same might be found to be true of annealed steel if suitable surface-grinding conditions were to be used. In any case it is premature to assume that centerless-grinding stresses in annealed bars are necessarily tensile.

The stress distributions shown in Fig. 10[4] should be considered a special rather than a typical example of surface-grinding stresses. The reason is that here the stress at the very surface was about 50 per cent higher for a unit downfeed of 0.0003 in. than for a unit downfeed almost ten times as great, or 0.0029 in. As was pointed out by the writer in his discussion of reference (15) of the paper, this reversal in the magnitude of the tensile stress was caused by grinding immediately after the wheel was dressed. Apparently, the dressing was such as to leave the wheel face rather dull, and the heavy downfeed was much more successful than the light downfeed in breaking down the wheel face and thus sharpening it, with a consequent reduction in the heat generated and in the tensile stress. This is a good example of the importance of grinding conditions with respect to the stresses produced.

[1] Metallurgical Engineer, Research and Development Department, Norton Company, Worcester, Mass. Mem. ASME.

[2] "Residual Stresses in Cold-Finished Steel Bars and Their Effects on Manufactured Parts," by E. S. Nachtman, MECHANICAL ENGINEERING, vol. 77, October, 1955, pp. 886–889.

[3] "Residual Grinding Stresses in Hardened Steel," by H. R. Letner, Trans. ASME, vol. 77, October, 1955, pp. 1089–1095.

[4] Refer to ASME Paper No. 55—5A-49, as presented. This figure does not appear in the condensed version.[2]

#### Author's Closure

We appreciate Dr. Tarasov's interest in putting the subject of grinding stresses into the "proper perspective." We both agree that information to date indicates that tensile stresses result from the grinding of mild steels.

We would look forward to work which might lead to the discovery of proper grinding techniques to produce compressive stresses—perhaps Dr. Tarasov will initiate work in this direction.

The original paper was not intended as a definitive study of residual stresses in cold-finished bars but rather it was hoped would encourage further work in this general area.

Elliot S. Natchman.[5]

[5] Manager, Product Engineering Laboratory, La Salle Steel Company, Hammond, Ind. Assoc. Mem. ASME.

### Managerial Control

#### Comment by David B. Hertz[6]

THE author's view of managerial control,[7] in light of a servomechanism model, is not new. However, it has not been fully explored by any means and it would seem that it has a great deal of merit. Servomechanism theory is a special case of systems theory, or in other terms, block-diagram theory.

There is no doubt that in dealing with directive processes such as managerial control, we are attempting to explore systems which may be described in terms of the servomechanism model. There is no question but that the author is correct in his view that "preventiveness" is the essential attribute of such a system in terms of business operation. However, it is less apparent that we should restrict kinds of control, which are encountered in business, to production, quality, and cost, and it is not clear that it is only these three elements which are to be integrated into a unified system.

As a matter of fact, the original view of quality control by Shewhart was that scientific control in business was a unified system of control which included economic control of the quality (and in this sense, the quantity) of manufactured goods. Shewhart's view, to which I heartily subscribe, was that these three aspects (i.e., quality, cost, and production) were necessarily unified if a control system was to work at all. Therefore I do not feel that the author's point in this case is necessarily new, although certainly still well put. On the other hand, his contribution, as to the correlation and unification of staff and line control activities, taken in the larger sense, should prove useful to many administrators.

[6] Manager of Operations Research, Popular Merchandise Company, Inc., New York, N. Y. Mem. ASME.

[7] "Managerial Control," by J. V. McKenna, MECHANICAL ENGINEERING, vol. 77, August, 1955, pp. 662–664.

#### Comment by R. E. McGarrah[8]

In the opinion of the writer, the author has contributed an explicitly worded paper on a subject which will always be vital to the successful operations of an industrial firm, regardless of the future trend toward automation.

With regard to the establishment of norms, one of "the four basic elements" of the control system, the statement is made that ". . . norms must be . . . stable." There is a growing body of knowledge about industrial operations which indicates that norms can never be stable, at least in the sense that the norms of a servomechanism system remain stable. For example, the manufacturing progress function (or "learning curve," which is an exponential of the form $y = ax^{-n}$), shows that with virtually any firm or any product, the labor time per unit of output decreases as the cumulative number of units produced

[8] Department of Industrial and Engineering Administration, Cornell University, Ithaca, N. Y.

increases.[9] This phenomenon suggests, for example, that the techniques of labor-cost control, based upon fixed time standards (i.e., norms) are not altogether feasible.

The same is true for the use of such time standards in production scheduling and control. Again, the dynamic characteristics of labor time norms is emphasized in the problems of maintaining the validity of these labor time standards. So-called "creeping methods changes," loose rates, labor grievances which develop if the validity of time standards is not maintained, all tend to demonstrate quite conclusively the fact that labor time norms are not stable, but are, rather, dynamic. In other words, when they are scientifically developed, the parameters used to measure norms of the production process are found to be stochastic (and not deterministic), over time. Therefore any statement about the stability of norms for managerial control systems should be qualified carefully in terms of the time period (months, weeks, years) over which stability can validly be assumed.

Certain norms are deterministic if evaluated on a long-run basis. For example, the production engineer who specifies that a piece part be manufactured on a turret lathe, might be correct in specifying this to be the best routing and method of manufacture, considering available machine tools in the plant. Frequently in production control, however, there are occasions when the turret lathes might be loaded with work orders to the extent that the required part cannot be produced on schedule. In this case a substitute method, involving the use of the available engine lathe might prove to be the best method to use. Although slower, and requiring more highly skilled operators, the available engine-lathe capacity provides the opportunity to meet the schedule. The design or norm for the production routing used is necessarily based upon long-term considerations, while the production control norm (i.e., the production schedule) is based upon the immediate period in question.

Another dilemma which the author has overlooked is what the operations researcher calls "optimal versus suboptimal" goals for programming operations. For example, in the control of production, the production dispatcher in an automatic-screw-machine department of the shop may logically base his decisions on the simple rule to minimize the machine down time due to setup changeover. Applying this rule would inevitably violate a rule of the production control department, which might logically require that sequence of dispatching of all jobs to machines be according to the due date specified on the production order. The screw-machine dispatcher knows that his department is more productive if the time for changing the machine setup is minimized. The production control department knows that the entire final-assembly department might be shut down if jobs are not dispatched to machines according to the due dates on the production orders. In this example it is clear that what is the optimal goal for the screw-machine-department dispatching routine is not optimal for the dispatch of jobs to the over-all factory operations, considered as a whole.

Briefly, it is the opinion of the writer that the author's expository on the subject of "basic theory of managerial control" is an oversimplification. In fact, he implies an admission of this in the final statement of his paper: "The problem of developing scientific norms for all activities which require control is complex and satisfactory answers are as yet beyond the horizon of current research."

[9] "Production Engineering in the Aircraft Industry," by A. B. Berghell, McGraw-Hill Book Company, Inc., New York, N. Y., 1944, and many others.

### Author's Closure

The author is indebted to Messrs. Hertz and McGarrah for their contributions. Mr. Hertz emphasizes the need for a single unified control system to include not only production, quality, and cost controls but all the others as well. In this the author concurs with but one reservation; systems which lack the element of preventiveness should not be combined with ones which possess it. Such systems are not control systems at all although they may be mistakenly labelled as such. For example, it is difficult to find the element of preventiveness in engineering control, human-relations control, and shop-layout control although these terms are used.

Mr. McGarrah's comment that "norms can never be stable" is entirely correct. From this fact arises a serious dilemma in the maintenance of control systems. If standards are not revised with sufficient frequency, they become obsolete in the sense that they no longer represent best attainable performance. If they are too frequently revised their maintenance will cost more than it should. Another serious deterrent to frequent revision is the impression sometimes given the workman that improved performance is met by continual rate cutting. The only way out seems to be that of expressing the standard as a variable in the first place, but this greatly complicates the operation of the system.

With respect to Mr. McGarrah's example of norms which are deterministic on a long-run basis, one cannot but agree that "use of the available engine lathe might prove to be the best method to use." This is irrevelent, however, with respect to the validity of the production-routing norm. Extra costs are involved which are charges upon the firm because it has not all the machines it needs. The deviation from the production-routing norm (which is reflected also in an unfavorable cost variance) serves its purpose by highlighting the deficiency.

The point of Mr. McGarrah's discussion of optimal versus suboptimal goals for programming is that two rules of scheduling are in conflict. The possibility, indeed the likelihood, of this is implied in the original article. The solution recommended is the development of a unified control system in which each of the specific controls is designed according to a common basic theory with arbitrary norms replaced by scientific ones.

J. V. McKenna.[10]

## Powder Metallurgy

### Comment by Jack K. Y. Hum[11]

THE authors have given an excellent summary[12] of the existing status of power reactors and the probable trends to come. They have given a good picture of the materials requirement and the difficulties which are to be expected by materials under nuclear-power service conditions.

It is the opinion of the writer that the trend of nuclear power is toward higher temperatures if it is to compete favorably with existing steam power plants. The question of enriched-fuel procurements will probably be academic in the near future when the supply of $U^{233}$, or $Pu^{239}$ becomes more plentiful, so that materials of not too desirable nuclear properties also can be considered for fuel-element fabrication.

It would appear that the corresponding problems which confront the jet-engine manufacturers also will face the fuel-element manufacturers, namely, that of finding ways and means of fabrication of metals and refractory materials for high-temperature service.

[10] Associate Professor of Industrial Engineering, College of Engineering, Syracuse University, Syracuse, N. Y.

[11] Metallurgist, Livermore Research Laboratory, University of California, Berkeley, Calif.

[12] "Powder Metallurgy—Its Role in the Design of Nuclear-Power Reactors," by H. H. Hausner and M. C. Kells, MECHANICAL ENGINEERING, vol. 77, August, 1955, pp. 665–669.

Unless the engineers can develop new techniques for the fabrication of these refractory materials, it seems that powder metallurgy offers the only solution so far offered.

### Comment by C. E. Weber[13]

The authors are to be congratulated for their paper pointing out the applicability of powder-metallurgy techniques in the design of nuclear reactors.

In the field of radiation effects the effect of fission products on the properties of a fissionable media should be mentioned. Like high-energy neutrons, recoiling fission products will also disturb a metal lattice and, in addition, will come to rest in the media. The "dynamic" effect and the "static" effect of fission products may be significant, depending on the concentration involved.

Commenting on the advantages offered the materials engineer by utilization of powder-metallurgy techniques, there is an additional advantage not stressed by the authors, namely, fabrication of alloys at low temperatures where little or no interaction may occur, in contrast to working at, or near, the melting point, with interaction resulting in a brittle or otherwise unsatisfactory product.

In the section on bonding for heat-transfer purposes, the increase in diffusion rate resulting from surface activity is discussed. To obtain such a good bond utilizing powders, allowance must be made for shrinkage of the metal compact which, depending on the geometry, may require concurrent deformation of the cladding to prevent shrinkage cracks from developing.

[13] Knolls Atomic Power Laboratory, General Electric Company, Schenectady, N. Y.

### Authors' Closure

The combination of refractory materials and metals by powder metallurgy does not play a role only in high-temperature power engines, such as jet propulsion and similar engines, but is also of great importance for nuclear-engineering purposes.

Uranium oxide in powder form can be uniformly distributed in a metal matrix such as stainless steel and a material of this type will permit the fabrication of fuel elements for operations at higher temperature and also has the advantage of considerably improved corrosion resistance. Powder metallurgy is the only practical way to produce metal-ceramic-type fuel elements.

The formation of alloys by powder metallurgy is one of the great advantages of this technique. The alloying between the component powders occurs as a solid-state reaction which can be controlled in a perfect way in any type of sintering furnace used for commercial powder-metallurgy production. However, care has to be taken that the sintering atmosphere is pure enough; whether vacuum or a neutral gas is to be used as a sintering atmosphere depends on the type of alloy to be formed.

H. H. Hausner.[14]
N. C. Kells.[15]

[14] Manager of Engineering, Atomic Energy Division, Sylvania Electric Products, Inc., Bayside, L. I., N. Y.

[15] Engineering Specialist, Atomic Energy Division, Sylvania Electric Products, Inc., Bayside, L. I., N. Y.

# Reviews of Books

## And Notes on Books Received in Engineering Societies Library

## The Foreseeable Future

THE FORESEEABLE FUTURE. By Sir George Thomson. Cambridge University Press, New York, N. Y., 1955. Cloth, $4\frac{1}{2} \times 7\frac{1}{2}$ in., vii and 166 pp., $2.50.

**Reviewed by F. S. Blackall, jr.[1]**

THE attempt to picture the nature of life in some future century long has been a favorite device of writers and philosophers. Such adventures into the crystal ball sometimes take the form of Messianic fiction, like Bellamy's "Looking Backward," providing a vehicle for the author's favorite views on the proper tenets of an ideal society. More often, they constitute pure fantasy, with a pseudoscientific basis like the current rash of pulps and comics dealing with Superman, space ships, and atomic disintegrators.

[1] President and Treasurer, The Taft-Peirce Manufacturing Company, Woonsocket, R. I. Past-President and Fellow ASME.

It has remained for Sir George Paget Thomson to assess, through the eyes of a scientist, the potentials of the future in the light of the sum total of basic knowledge and technology and to compress it all into a pocket-size volume of 160-odd pages.

The author seems well qualified for his task. Eminent son of a distinguished parent, Sir J. J. Thomson, Sir George is a noted scientist and educator in his own right—Nobel Laureate for Physics and Master of Corpus Christi at Cambridge. What is perhaps equally important, for present purposes, he is blessed with an extremely facile pen.

Here and there, to be sure, he supports his speculations with references to mathematical or scientific theory, such as quantum mechanics, which are somewhat beyond the experience of the average reader, unless he be a specialist, but these cases are the exception rather than the rule, and the volume is an eminently readable one. The author deals, in swift and penetrating succession, with the indicated trends in the fields of power, materials, transport and communications, weather, food, and biology, and then takes a glimpse at the social and psychological consequences of the changes which he envisions.

Atomic energy emerges as a blessing rather than the scourge of mankind, which will liberate us from dependence on fossil fuels, the end of which is at least foreseeable. Nuclear power will make possible large cargo-carrying submarines, which will move the ocean's bulk freight under the sea rather than over it at speeds of 75 miles per hour and efficiencies presently unattainable. Travel by air seems destined to remain what it primarily is, the province of the common carrier. The automobile will continue to be the vehicle of private transportation, although Sir George neglects to offer a solution for the twenty-first century traffic

problem. Nor does he seem alarmed about an overgrowth of population, merely because the world birth rate is momentarily in a rapidly rising cycle.

History suggests that a Malthusian slowing down of the process of population growth will occur before overcrowding of the globe becomes critical. And, says the author, the current trend toward larger families is a planned and intentional one, based on other considerations than the elementary sex urge, which quite as readily would be reversed under other circumstances. Meanwhile, the problem of feeding a much larger world population than we now have can be met by any one of several approaches, by photosynthesis of high-protein animal feed, by chemical synthesis of organic foodstuffs, by the simple extension and improvement of agriculture, which today utilizes less than nine per cent of the world's arable land. But here the author, as a man, momentarily displaces the author as a scientist. What fun we could have, hunting and fishing, he muses, if we were to convert the fields of grain to parkland, restore domesticated herds to wildlife, and leave the production of food to more efficient artificial processes in factories. In occasional flashes like this, one detects the tongue in cheek and a pleasing, if lofty, sense of humor, all of which makes the volume the more engaging.

Net evaluation: A thought-provoking and objectively serious work, written with a disarming simplicity which belies the deep thought and wisdom which must have gone into its preparation. Soundly imaginative, at times exciting, reading for the engineer and scientist, and even for the general reader of respectable I.Q.

## Turboblowers

TURBOBLOWERS: Theory, design, and application of centrifugal and axial-flow compressors and fans. By A. J. Stepanoff. John Wiley & Sons, Inc., New York, N. Y.; Chapman & Hall, Ltd., London, England, 1955. Cloth, 5½ × 9 in., tables, diagrams, references, index, ix and 377 pp., $8.

**Reviewed by Ronald B. Smith**[2]

THIS text, by an international authority in the field of hydraulic machinery, is one of the few in any language, and certainly one of the best in English, devoted exclusively to an exposition of the fundamental principles involved in the design and performance of turbocompressors. Drawing upon a rich background in the design of pumps, the author points to the basic similarity between that machine and the centrifugal compressor. Herein lies the greatest strength of the work and, to a considerable degree, its weakness too, for although the analogies between the two pieces of apparatus are legion and have frequently been slighted by those working in the compressible field, there are at the same time basic differences, generally associated with the Mach and the Reynolds number, which impose additional restraints in the design of turbocompressors. In the attempt to establish the positive, these differences are sometimes handled in a more superficial manner than is warranted by modern, high-speed, centrifugal, and axial-compressor practice.

The general text and treatment follows Continental lines, particularly the work of Pfleiderer, and is sound, purposeful, and clear. While the volume, as a whole, may lack the éclat of certain classic treatises on turbomachinery, particularly in its development of thermodynamic principles, it is a highly professional work and clearly one whose author has an intuitive feeling of the significant physical relationships involved in the design of centrifugal machines.

The text falls logically into five groupings. The first, consisting of six chapters, treats the incompressible fluid and develops the mechanics of the velocity diagrams, the concept of head and of work, and the general performance variables of the turbomachine. This is a particularly strong exposé and culminates in a most ingenious characteristic diagram for the compressor stage. The author cleverly ties together from pump experience the zero-flow and zero-head characteristics, as well as the best point performance versus specific speed, and persuasively argues that they define the compressible fluid regime also. It is unfortunate that the author did not have available some of the excellent single-stage test data developed on radial impellers to substantiate his premises. Modern centrifugal machines are moving to this general configuration largely as a result of the work on superchargers where, with high-tip speeds and heavily loaded diffusers, excellent performance has been achieved. This is hardly the same machine as the 25 deg backward-vaned impeller with volute casing used on many pumps.

The group of chapters devoted to thermodynamics and to cooling develop the basic deviation between the compressible and the incompressible fluid, and the concept of a polytropic compression. The special property of a polytropic, namely, that of an adiabatic wherein the internal losses are proportional to the change in enthalpy, is not highlighted. There are other places, too, where the thermodynamics is lacking in rigor, and the concept of the continuity equation as "a man-made law" in a secondary position to Newton's "Law of Nature" is unorthodox. The author's insistence on second-law analysis using the availability concept, and on explanations drawn from the T-S rather than the enthalpy diagram, does not add clarity or ease to the general treatment. However, the end result is satisfactory and, as developed, undoubtedly more pleasing to Mr. Stepanoff.

The parasitic losses of turbomachines, such as leakage, disk friction, and so on, are well treated but the author avoids any analysis of stream losses and prefers instead the test-model approach. While this is the safest, and perhaps soundest technique, it can also be so expensive that it leads to conservatism in engineering design. In the centrifugal compressor the major losses are generally downstream from the impeller in a region of decelerating flow. A rational treatment of this condition is difficult but well deserving of effort.

In the chapters devoted to axial-flow fans and compressors, the author follows divergent paths. From long experience with propeller pumps, he prefers to develop the design of fans from vane theory. He treats the axial fan as a special configuration of the centrifugal compressor and ties the two neatly together. For the axial-flow compressor, wherein he follows the developments of Constant and Howell in England, he readily accepts the cascade test. The author as well as the late H. F. (Heinie) Schmidt was an early advocate of a forced vortex flow through an axial machine and it is with considerable satisfaction that he observes the trend in this direction by axial-compressor designers. Generally the treatment of the axial compressor is sound and concise, but it admittedly lacks the originality of much of the other material in the book.

The chapters on the effects of internal and external cooling of centrifugal compressors, their performance under altered operating conditions, and their means of control are all excellent. In these the author rationalizes the various influences and ties them in closely with the theoretical treatment of early chapters. This portion is a must for application engineers.

While this volume may not be all things to all people it is still a piece of work that many would be proud to have been capable of writing. It is one long needed and deserving of a warm welcome from the profession at large.

[2] Vice-President—Operations, The M. W. Kellogg Company, New York, N. Y. Mem. ASME.

# Books Received in Library

ATLAS ZUR WÄRMEBEHANDLUNG DER STÄHLE. Edited by Max-Planck Institute für Eisenforschung with Werkstoffausschuss des Vereins Deutscher Eisenhüttenleute. Verlag Stahleisen, Düsseldorf, Germany, 1955. Various paging, 12 × 9½ in., loose-leaf binding. 70 DM. This steel heat-treating atlas presents a compilation of time-temperature-transformation diagrams based principally on test data compiled (in part by new methods) at the Max-Planck Institute für Eisenforschung. Part 1, in addition to the explanatory text, contains a bibliography of 216 references to German, American, and British literature on transformation diagrams with an index arranged according to carbon content. Part 2 is the atlas proper giving graphic data on 19 steels.

DESIGN OF HEATING AND VENTILATING SYSTEMS. By F. W. Hutchinson. Industrial Press, New York, N. Y., 1955. 308 p., 9¼ × 6¼ in., bound. $7. Intended to supplement rather than to replace standard texts in the field, this book emphasizes the elements of the system which require the rational application of engineering knowledge. Considerable space is allotted to the factors involved in determining loads—transmission losses, intermittent heating, ventilation, humidification, and losses from ducts—and design procedures are given for panel and solar heating as well as for conventional systems. Full-page graphical solutions of important equations are included, along with basic data for solving many practical problems.

DIGITAL DIFFERENTIAL ANALYZERS. Part 1, Elements. By George F. Forbes, 10117 Bartee Avenue, Pacoima, Calif., second edition, 1955. 48 p., 11 × 8½ in., paper. $5. Basic integrator mechanisms are shown for the generation of exponential, trigonometric, algebraic, and inverse trigonometric functions. Adders and servos are also discussed, and techniques for their effective use presented. Tables of pertinent number systems and their conversions are supplied in an appendix.

GAS TURBINES AND JET PROPULSION. By G. Geoffrey Smith. Philosophical Library, Inc., New York, N. Y., sixth edition, 1955. 412 p., 8¾ × 5½ in., bound. $15. Concerned mainly with airplane engines, this book covers basic principles, thrust and performance, the relative efficiency of jets and airscrews, components, combustion, metallurgical problems, testing, and maintenance. It also contains descriptions of current American, British, Canadian, and European gas turbines, a chapter on ramjets, pulsijets, and rockets, and brief discussions on gas turbines for automobiles, locomotives, ships, and for various industrial applications.

GESTALTUNG VON FAHRZEUGGETRIEBEN. (Konstruktionsbücher 15.) By Hans Reichenbächer. Springer-Verlag, Berlin, Germany, 1955. 154 p., 9¼ × 6¼ in., bound. 26.40 DM. A review of the principles and construction of present-day German and American automotive transmissions. Intended for the design engineer, it covers sliding-gear transmissions, fluid couplings, and torque converters, including free-wheeling, overdrive, synchromesh, planetary systems, and special types such as hydramatic. There are many graphs and sketches.

HANDBOOK OF BARREL FINISHING. By Ralph Enyedy. Reinhold Publishing Corporation, New York, N. Y., 1955. 255 p., 10⅛ × 7⅛ in., bound. $7.50. This volume is for the most part made up of concise, step-by-step descriptions of the basic types of finishing methods illustrated by case histories of the actual finishing of parts of a wide variety of types and shapes. The methods covered include self-tumbling, tumbling with chips, polishing and burnishing, coloring, use of the multibarrel, and many others. The book also contains discussions of the economies realized by the use of this type of finishing, organization of a department, layouts, finishing compounds, and equipment.

HYDRAULIC AND PNEUMATIC OPERATION OF MACHINES. By H. C. Town. Philosophical Library, Inc., New York, N. Y., 1956. 192 p., 9 × 6 in., bound. $7.50. The first part of this book provides practical information on pumps, valves, circuits, and rotary drive; hydraulic machine-tool operation; and hydraulic presses. Also dealt with in this part are general features of the design of cylinders, pipe lines, and protection devices; hydrokinetic automobile transmission; automotive controls; and hydraulic accumulators. The second part of the book covers air compressors; pneumatic tools; the design of pneumatic circuits; hydropneumatic operation; and applications of air control to jigs and fixtures, brakes, clutches, conveyers, and aircraft components.

LINEAR FEEDBACK ANALYSIS. By J. G. Thomason. McGraw-Hill Book Company, Inc., New York, N. Y., 1955. 355 p., 8¾ × 5½ in., bound. $8.50. Intended to provide the analytical background for work in electronics or servomechanism research, this book covers modern network analysis methods, feedback concepts, tube-amplifying characteristics and, in considerable detail, stability in negative feedback systems. Three chapters are devoted to illustrative descriptions of amplifier, integrator, differentiator, and stabilized-power unit circuits.

METALS HANDBOOK. 1955 Supplement. Edited by Taylor Lyman. American Society for Metals, Cleveland, Ohio, 1955. 208 p., 11 × 8⅜ in., bound. $6. The second in a series of supplements issued in order to make important material available sooner than would be the case if it were held until the revision of the 1948 Handbook is completed. Various aspects of materials and applications, design, processing, fabricating, testing, and inspection are dealt with in articles which are either entirely new or are revised treatments of subjects previously covered.

ORIENTATION IN ENGINEERING. By Murray I. Mantell, Milton E. Reeder, and John A. Stevens. Prentice-Hall, Inc., Englewood Cliffs, N. J., 1955. 85 p., 10¾ × 7⅞ in., paper. $1.75. With the aim of helping students to adjust to college life, to clarify their ideas of the engineering college and profession, and to learn fundamental skills, this book considers such topics as classroom honesty, extra-curricular activities, studying, examinations, the use of libraries, the slide rule, and dimensional analysis. It also discusses the development of the engineering profession, engineering specialization, and the function of engineering education. Written assignments at the end of each section provide a basis for class discussion.

PIPING STRESS CALCULATIONS SIMPLIFIED. By S. W. Spielvogel, 15 Old Field Lane, Lake Success, N. Y., fifth edition, 1955. 183 p., 11¼ × 9¼ in., leatherette. $5. This book provides practical aids to designers of piping layouts by presenting exact solutions in arithmetical form to a number of typical problems in the calculation of pipe stress under changing temperature conditions. The present edition incorporates the provisions of the 1955 American Standards Association "Code for Pressure Piping."

REACTOR HANDBOOK. Physics; Materials; General Properties; Engineering. United States Atomic Energy Commission. McGraw-Hill Book Company, Inc., New York, N. Y., 1955. 790 p., 610 p., 1075 p., 10½ × 8½ in., bound. $12, $10.50, $15. The three large volumes of this new handbook provide an extensive source of reliable data for those working in the reactor field. The physics volume covers theoretical and experimental techniques for the design and evaluation of experimental and research reactors and includes a section on reactor-shield design. The volume on materials presents information on the availability, processing, and properties of metals and alloys, ceramics, carbides, and other solid materials used in reactor applications. The engineering volume covers the design of the various types of fluid-fuel reactors and of fixed-fuel reactors using water, liquid metal, or gas cooling. Methods for performing remote-handling and control operations are included.

RESEARCH REACTORS. United States Atomic Energy Commission. McGraw-Hill Book Company, Inc., New York, N. Y., 1955. 442 p., 10½ × 8 in., bound. $6.50. This book gives descriptions of three types of light-water-moderated reactors (pool, solution, and materials testing), and of three other types: hydro-carbon moderated; heavy-water moderated, and graphite-moderated. Information given for each type includes general design features, core design and fuel handling, cooling system (where applicable), control and instrumentation, shielding, experimental facilities, and operating characteristics. The book was prepared originally for the International Conference on Peaceful Uses of Atomic Energy.

SPONTANEOUS IGNITION OF LIQUID FUELS. (Agardograph 4.) By B. P. Mullins. Published for Advisory Group for Aeronautical Research and Development by Butterworths Scientific Publications, London (distributed in U. S. by Interscience Publishers, Inc., New York, N. Y.), 1955. 117 p., 10 × 6 in., bound. $2.75. Eight chapters of this book deal with spontaneous-ignition temperature under the various test methods by which the data were obtained—crucible, bomb, adiabatic compression, flow, heated surface, and other methods. One chapter summarizes ignition data for 433 substances, and the remaining chapters cover general theoretical considerations, fuel addi-

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tives, and applications. A bibliography of over four hundred references is included.

TECHNICAL PUBLICATIONS. By C. Baker. John Wiley & Sons, Inc., New York, N. Y., 1955. 302 p., $8^3/_4 \times 5^1/_2$ in., bound. $6. This is a guide specifically intended to aid engineers and other technicians in the preparation of engineering manuals, instructional leaflets, reports, and other types of technical publications. It deals with the selection of a style suited to the user, the use of clear language, methods of presentation, the use of illustrations, methods of reproduction, and preparation of copy for printing. Also briefly discussed is the use of technical literature in the aircraft industry, questionnaires, and specification writing.

TESTING OF HIGH SPEED INTERNAL COMBUSTION ENGINES. By Arthur W. Judge. Chapman & Hall, Ltd., London, England, fourth edition, 1955. 494 p., $9 \times 5^3/_4$ in., bound. 75s. An extensively revised edition of a standard work on the principles, procedures, instruments, and methods for testing fuel, exhaust, air supply, water supply, temperature, and other factors affecting engine performance. The testing of compression-ignition engines, gas turbines, and aircraft engines is treated at length in separate chapters, and relevant formulas, standard atmosphere data, supercharger calculations, and other useful information are supplied in appendixes.

THEORETISCHE UND EXPERIMENTELLE UNTERSUCHUNGEN ÜBER DAS DE SAINT-VENANTSCHE PRINZIP, SPEZIELL MIT ANWENDUNG AUF DIE PLATTENTHEORIE. (École Polytechnique Fedérale, Zurich, Switzerland. Publications du Laboratoire de Photoélasticité, no. 6.) By Walter Schumann. Editions Leemann, Zurich, 1955. 84 p., $9^1/_2 \times 6^3/_8$ in., paper. 10.50 Sw.fr. A theoretical and experimental investigation of Saint-Venant's principle as an important aspect of elasticity theory, with special reference to its application to the theory of plates. A section is devoted to photoelastic methods.

TRAGFÄHIGSTE EVOLVENTEN-GERADVERZAHNUNG. (Schriftenreihe Antriebstechnik, no. 15.) By Hans Winter and Gustav Niemann. Friedr. Vieweg & Sohn, Braunschweig, Germany, 1954. 99 p., 142 p., $9^1/_4 \times 6^1/_2$ in., boards. 17.80 DM. After a critical examination of the more important proposed and existing tooth systems for involute spur gears the author presents in detail a general plan for their comparative analysis. An important aspect investigated is the maximum load-carrying capacity. An extensive compilation of tables and graphs is provided in separate form to aid in the various analyses.

THEORY OF MACHINES. By W. G. Green. Blackie & Son Ltd., Glasgow, Scotland, 1955. 1034 p., $8^3/_4 \times 6^1/_4$ in., bound. 40s. The opening chapters of this book present the fundamentals of the dynamics of a particle and rigid body and give a preliminary survey of the geometric and graphical approach to the kinematics of machinery. Later chapters deal with the direct-acting engine mechanism; balancing; governors; valves; friction; brakes; gearing; and related subjects. A large number of worked examples are included.

DER WECHSELSPRUNG MIT FREIER DECKWALZE. (Mitteilungen aus dem Gebiete des Wasserbaues und der Baugrundforschung, Heft 17.) By Paul-Gerhard Franke. Wilhelm Ernst & Sohn, Berlin, Germany, 1955. 68 p., $9^3/_8 \times 6^3/_8$ in., paper. 9.80 DM. A detailed analysis of the results of a series of hydraulic laboratory experiments on the hydraulic jump with free standing wave. There are four sections: theoretical considerations; test results; conclusions; bibliography. A feature of the experiments was the accuracy of the measurements.

ZAHNRÄDER—ZAHNRADGETRIEBE. (Schriftenreihe Antriebstechnik, no. 16.) Friedr. Vieweg & Sohn, Braunschweig, Germany, 1955. 266 p., $9^1/_4 \times 6^3/_4$ in., bound. 24.50 DM. The twenty-five papers included in this volume deal with various aspects of design, production, and economics in connection with the manufacture of gears; with the construction of gear drives; and with some phases of gear operation. Heat-treating methods are dealt with in particular.

# ASME Boiler and Pressure Vessel Code

## Interpretations

THE Boiler and Pressure Vessel Committee meets monthly to consider "Cases" where users have found difficulty in interpreting the Code. These pass through the following procedure: (1) Inquiries are submitted by letter to the Secretary of the Boiler and Pressure Vessel Committee, ASME, 29 West 39th Street, New York 18, N. Y.; (2) Copies are distributed to Committee members for study; (3) At the next Committee Meeting interpretations are formulated to be submitted to the ASME Board on Codes and Standards, authorized by the Council of the Society to pass upon them; (4) They are submitted to the Board for action; (5) Those which are approved are sent to the inquirers and are published in MECHANICAL ENGINEERING.

(The following Case Interpretations were formulated at the Committee Meeting, November 4, 1955, and approved by the Board on December 27, 1955.)

### Case No. 1204-2 (Reopened)

*(Special Ruling)*

***Revise Reply item 11 to read:***

(11) All parts shall be made of the material specified in the Inquiry, except that pipe flanges or pipe of carbon steel may be welded to nozzle necks of the material specified in the Inquiry provided the butt weld is located more than a distance equal to the square root of $r \times t$ measured from the face of the reinforcement, where $r$ = the inside radius of the nozzle neck and $t$ = the thickness of the nozzle neck at the surface of the vessel or reinforcing plate if one is used. The design of the nozzle neck shall be made on the basis of the allowable stress value of the weaker material.

### Case No. 1210

*(Interpretation of Par. P-216)*

*Inquiry:* Is it the intent of Par. P-216 to permit the omission of stays in the head of fire-tube boilers when added head thickness is provided by doubling plates, thereby increasing the allowable pitch so $1^1/_2\ p$ is greater than the distance from the top of the tubes to the shell? Doubling plates are provided for in Par. P-199(c).

*Reply:* It is the opinion of the Committee that Par. P-216 is not intended to permit the omission of stays by the use of doubling plates. Doubling plates are provided for in Par. P-199(c) only when the surface is stayed by braces. Specific limitations for the use of structural stiffeners in segments over the tubes are provided only in Pars. P-225 to P-229.

### Case No. 1211

*(Special Ruling)*

*Inquiry:* May cast nodular iron which meets the requirements of SA-278 Class 60 cast iron in all respects except for the carbon content equivalent, be used for pressure parts for containing all except lethal substances at pressures not exceeding 300 psi at temperatures permitted in Part UCI of Section VIII?

*Reply:* It is the opinion of the Committee that cast nodular iron meeting the requirements of SA-278 Class 60 cast iron except for the carbon content equivalent may be used for pressure parts for containing all except lethal substances at pressures not exceeding 300 psi at temperatures permitted in Part UCI of Section VIII provided:

(1) The tensile strength is not less than 60,000 psi.

(2) The yield strength is not less than 45,000 psi.

(3) The carbon content equivalent is controlled to provide a minimum elongation in two inches of 15 per cent.

(4) All castings are given a ferritizing anneal.

(5) No repairs are made by welding or brazing.

(6) The material is not used at service temperatures below −20 F except for lower temperatures due to seasonal temperature.

(7) All other requirements of Part UCI are met.

### Case No. 1212

***(Interpretation of Par. H-73(c))***

*Inquiry:* May an inert-gas metal arc welding process be used under the limits of Par. H-73(c) if the tensile strength of the deposited metal is greater than 72,000 psi? It is pointed out that the problem of over-matching weld strength with parent metal will not occur in plate thicknesses used under the rules of Section IV.

*Reply:* It is the opinion of the Committee that a welding process resulting in weld metal with tensile strength greater than 72,000 psi may be considered to comply with the requirements of Par. H-73(c) when used in welding boilers designed under the rules of Section IV provided the welding operators and procedures are qualified using the process. The Committee is considering a Code revision which will delete the maximum tensile strength limit from this paragraph.

### Annulment of Cases

The following cases are annulled:

| CASE NO. | REASON FOR ANNULMENT |
|---|---|
| 1156 | Specification now included in Table P-6. |
| 1160 | Essence of Case now included in Table P-7, Note 11. |
| 1170-1 | Essence of Case now included in Table P-2. |
| 1172 | Specification now included in Par. P-186(e). |

## Proposed Revisions and Addenda to Boiler and Pressure Vessel Code . . .

As NEED arises, the Boiler and Pressure Vessel Committee entertains suggestions for revising its Code. Revisions approved by the Committee are published here as proposed addenda to the Code to invite criticism. If and as finally approved by the ASME Board of Codes and Standards, and formally adopted by the Council, they are printed in the annual addenda supplements to the Code. Triennially the addenda are incorporated into a new edition of the Code.

In the following the paragraph numbers indicate where the proposed revisions would apply in the various sections of the Code.

Comments should be addressed to the Secretary of the Boiler and Pressure Vessel Committee, ASME, 29 West 39th Street, New York 18, N. Y.

### Low-Pressure Heating Boilers, 1952

PAR. H-73(c) Delete the words: "...but in no case greater than 72,000 psi."

### Unfired Pressure Vessels, 1952

Figs. UNF-28.11 and UNF-28.12, Charts for Determining Shell Thickness of Cylindrical and Spherical Vessels under External Pressure When Constructed of Annealed 70-30 and 90-10 Copper-Nickel Alloy, respectively, have been revised and copies can be obtained from the Secretary of the Boiler and Pressure Vessel Committee, ASME, 29 West 39th St., New York 18, N. Y.

TABLE UHA-23 Under Plate Steels, add the following stress values:

| Matl. & Spec. No. | Grade | Type | Nom. Comp. | Specified Min. Tensile | Notes |
|---|---|---|---|---|---|
| PLATE STEELS | | | | | |
| SA-167 | 2 | 302 | 18 Cr-8 Ni | 75000 | (1) |
| SA-167 | 2 | 302 | 18 Cr-8 Ni | 75000 | ... |

| For Metal Temperatures Not Exceeding Deg F | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| −20 to 100 | 200 | 300 | 400 | 500 | 600 | 650 | 700 | 750 |
| 18750 | 17000 | 16000 | 15450 | 15100 | 14900 | 14850 | 14800 | 14700 |
| 18750 | 16650 | 15000 | 13650 | 12500 | 11600 | 11200 | 10800 | 10400 |

PAR. UCS-56(a)(1) Add the words "SA-357 and SA-387 Grades B, C, D, and E" to the list of specifications included therein.

PAR. UCS-56(a)(2) Add the following: "SA-387 Grade A," to the list of specifications included therein.

PAR. UCS-57 Revise the last part of the first sentence to read: "..... and for each butt welded joint in vessels built of steel complying with Specifications SA-353, SA-357, and SA-387, Grades D and E for all plate thicknesses."

### Welding Qualifications, 1953

TABLE Q-11.1 Add the accompanying specifications under the respective P-number.

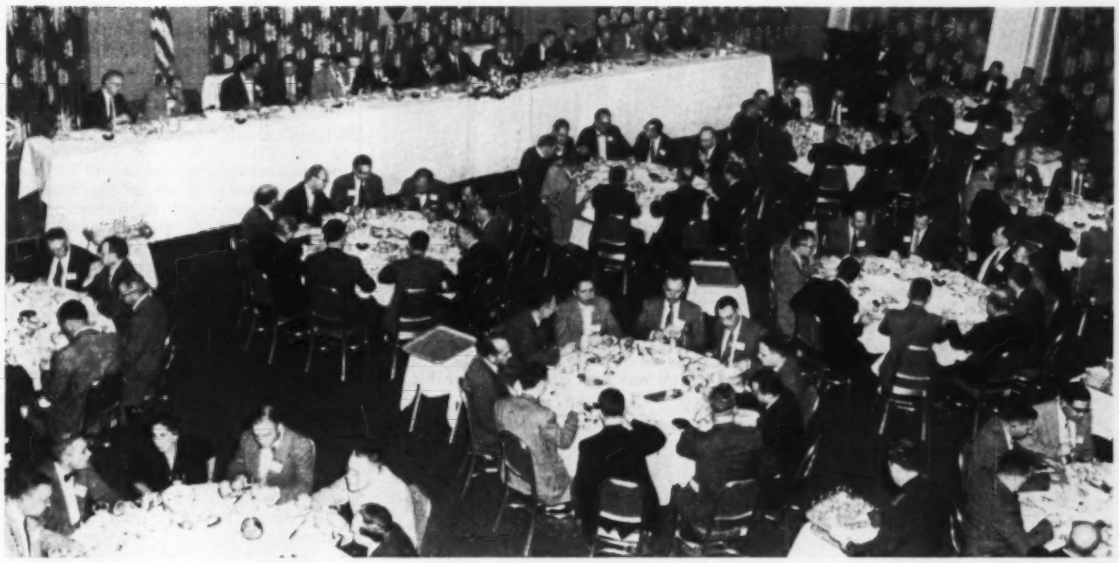
SPECIFICATIONS TO BE ADDED TO TABLE Q-11.1

| P-NUMBER 1 Mat'l. Spec. | PSI Min. Tensile | Type of Material |
|---|---|---|
| SA-179 | Not specified | Carbon Steel Seamless Low Carbon Steel Tubes |
| SA-214 | Not specified | Carbon Steel Electric Resistance Welded Tubes |
| P-NUMBER 3 | | |
| SA-387 Grade A | 65,000 | Cr-Mo Steel Plates (0.50 Cr-0.50 Mo) |
| P-NUMBER 4 | | |
| SA-199 Grade T3b | 60,000 | Cr-Mo Seamless Steel Tubes (2.00 Cr-0.50 Mo) |
| Grade T11 | 60,000 | Cr-Mo Seamless Steel Tubes (1.25 Cr-0.50 Mo) |
| SA-387 Grade B | 60,000 | Cr-Mo Steel Plates (1.00 Cr-0.50 Mo) |
| Grade C | 60,000 | Cr-Mo Steel Plates (1.25 Cr-0.50 Mo) |
| P-NUMBER 5 | | |
| SA-199 Grade T4 | 60,000 | Cr-Mo Seamless Steel Tubes (2.50 Cr-0.50 Mo) |
| Grade T5 | 60,000 | Cr-Mo Seamless Steel Tubes (5.00 Cr-0.50 Mo) |
| Grade T7 | 60,000 | Cr-Mo Seamless Steel Tubes (7.00 Cr-0.50 Mo) |
| Grade T9 | 60,000 | Cr-Mo Seamless Steel Tubes (9.00 Cr-1.00 Mo) |
| Grade T21 | 60,000 | Cr-Mo Seamless Steel Tubes (3.00 Cr-1.00 Mo) |
| Grade T22 | 60,000 | Cr-Mo Seamless Steel Tubes (2.25 Cr-1.00 Mo) |
| SA-387 Grade D | 60,000 | Cr-Mo Steel Plates (2.25 Cr-1.00 Mo) |
| Grade E | 60,000 | Cr-Mo Steel Plates (3.00 Cr-1.00 Mo) |
| P-NUMBER 8 | | |
| SA-376 Grade TP-304 | 75,000 | AISI-304 Seamless Alloy Steel Tubes |
| Grade TP-321 | 75,000 | AISI-321 Seamless Alloy Steel Tubes |
| Grade TP-347 | 75,000 | AISI-347 Seamless Alloy Steel Tubes |
| Grade TP-316 | 75,000 | AISI-316 Seamless Alloy Steel Tubes |
| P-NUMBER 10 | | |
| SA-353 | 90,000 | Low Carbon Ni-Steel Plates (9 Ni) |

# ASME News

## With Notes on the Engineering Profession

E. S. Newman, *News Editor*



View shows head table and section of audience attending opening dinner of EJC Nuclear Engineering and Science Congress, Cleveland, Ohio, Dec. 12, 1955. The history-making Congress was the combined effort of 26 engineering and scientific societies comprising more than 400,000 members. For the first time in the United States engineers and scientists were assembled to discuss means of increasing scientific and industrial nuclear progress. The dinner was sponsored by AIChE at the Cleveland Engineering Society. C. E. Larson, vice-president, Research, National Carbon Company, the principal speaker, addressed a large audience representing all of the participating societies and their associates.

# ASME Papers Make Notable Contribution to First Nuclear Engineering Congress Held in United States

## *Admiral L. L. Strauss Deplores Lack of Trained Engineers and Scientists for Atoms-for-Peace Program. Thousands Visit Atomic Exposition*

More than 3000 engineers, scientists, and physicists—with all barriers down—presented the greatest aggregate of nuclear technology yet heard in the United States. The Engineers Joint Council co-ordinated the efforts of its constituent societies, of which The American Society of Mechanical Engineers is one, in conjunction with several participating scientific societies, to produce the first Nuclear Engineering and Science Congress, in Cleveland, Ohio, Dec. 12–16, 1955.

True to the prediction made by Thorndike Saville, EJC president and dean of the School of Engineering, New York University, the more than 225 technical papers covering some 50 fields of nuclear engineering opened new avenues for the peaceful application of atomic developments.

Simultaneously, the 1955 International Atomic Exposition, sponsored by the American Institute of Chemical Engineers, displayed the wares of 176 commercial enterprises, 16 foreign, to more than 18,000 scientific, engineering, and casual visitors including college and high-school students from which the next generation of nuclear scientists and engineers must be recruited.

### Admiral Strauss Addresses All-Congress Dinner

L. L. Strauss, Chairman of the United States Atomic Energy Commission, was the

**Thorndike Saville, *left,* president of Engineers Joint Council and dean of the College of Engineering, New York University, welcomes guests to All-Congress Dinner of the Nuclear Engineering and Science Congress. Shown, *left to right,* with Dean Saville are: John R. Dunning, Mem. ASME, dean, School of Engineering, Columbia University; L. L. Strauss, chairman, United States Atomic Energy Commission, and principal speaker at the banquet; and ASME President Joseph W. Barker. Admiral Strauss is shown holding volume 3, "Power Reactors," of the Proceedings of the International Conference on Peaceful Uses of Atomic Energy which was recently published by the United Nations and which was part of the UN exhibit at the Atomic Exposition.**

principal speaker at the All-Congress Dinner, a major event of the Congress.

Admiral Strauss stressed the need for more trained engineers and scientists. He said, "Our liberty and that of the free world might be jeopardized for want of men possessing the skills to produce atom-powered ships and planes, or to develop modern nuclear weapons more quickly and more efficiently than other nations."

We must have a large reservoir of scientific and engineering talent and make certain that this reservoir is constantly replenished, otherwise as a nation we will be out-distanced and left behind, he stated.

Admiral Strauss remarked he was confident that the day will come, although probably not for years, when the way will be found to produce nuclear power by harnessing the same energy release that we assume is taking place in the sun—the process of the controlled fusion of light nuclei. Scientists in the Commission's laboratories are at work on the problem, searching for the key—the elusive "big idea" that could revolutionize the atomic art. But our people are not the only ones. Competent scientists in other countries are equally hard at work, trying to find the same big idea. Unless we have scientists and engineers in quality and numbers, we could lose the race.

Speaking on atomic energy for power, Admiral Strauss said, "We are training fewer than 500 persons a year to take their places in the vital and challenging field of atomic power, whereas there is a *current* need of three or four times that number. It is evident that our present training rate is woefully short of our needs.

"It has been estimated—and, I think, too conservatively—that in 20 years our country will be generating over 80-million kw of electricity from atomic energy. This means that, 20 years hence, we will need at least 23,000 engineers and scientists in the field of civilian atomic power, or nearly five times our present number. If we add to this the requirements of the military-power program—which, of course, contributes importantly to our civilian-power research and development—then the need 20 years hence will be not 23,000 but 30,000 or more. It means close to 1500 new trained men every year, whereas, as I have said, we are presently training fewer than 500 a year."

He urged the professional scientific and engineering societies to help AEC to convince industry "that the great majority of the people who will work in atomic energy do not require long-term intensive training, and that previous experience in other fields is as important as specialized knowledge of atomic energy. A substantial step will have been made toward solving the problem."

Admiral Strauss announced that an institute for faculty members of American engineering colleges would be established next summer. The faculty members will train teachers and instructors in atomic technology. (See page 191 of this issue.)

## Unclassified Information

During the Congress two pamphlets were brought to the attention of the attendees which should prove to be of value to persons interested in this field. They are:

"What's Available in the Unclassified Atomic Energy Literature and Where You Find It," available from the Industrial Information Branch of the U. S. AEC, Washington 25, D. C.; and another, also available for the asking, concerns the businessman who needs general information on unclassified and classified reports. It includes a list of depository libraries where literally thousands of documents may be inspected without charge.

## Technical Program

More than 223 technical papers, presented in 50 sessions, discussed highly specific areas of nuclear technology, constituting in many cases a round-table meeting of the experts in a given field. Of distinct importance for consideration in planning any future nuclear meetings is the fact that many of these sessions cut across two or more of the conventional disciplines usually ascribed to each of the

**Gunnar Randers, *center,* director, Joint Establishment for Atomic Energy Research, Norway, addresses AIChE banquet held December 13 in conjunction with the EJC Nuclear Engineering and Science Congress. Dr. Randers said he could see no realistic reason why there should not be an international atomic-energy agency and added that 84 countries will assemble to thrash out the problems of nuclear control on a world-wide scale next summer. Also shown at the head table, *left to right,* are: Donald L. Katz, Mem. ASME, chairman, Program Committee for the Congress; John R. Dunning, Mem. ASME, chairman, General Congress Committee of EJC; Dr. Randers; R. P. Genereaux; and B. F. Dodge, president, AIChE.**

several societies or associations. That is, in a single session, often in a single paper, matters of concern to electrical, civil, mechanical, metallurgical, and chemical engineers were involved, with obvious references to basic science. Thus the concept of a Congress sponsored by a number of societies was proved a proper one, and probably essential for the future.

The past year has seen the greatest release of technical information ever published in a 12-month period. The Atomic Energy Act of 1954 made possible the declassification of information developed over a long period of years; the Geneva Conference provided the incentive; and the influx of many new companies and projects demanded publication of the rapidly developing technology.

Affairs of the Congress were administered by a committee composed of representatives of many of the co-operating societies under the chairmanship of John R. Dunning, Mem. ASME, dean of the School of Engineering, Columbia University. In addition to this committee, under the sponsorship of the Engineers Joint Council, a program and a publications committee were established early in 1955. A considered decision of the publications committee provided that all available papers would be multilithographed and made available through the AIChE. A list of titles had been distributed through each of the co-operating societies and repeated in the Congress program. Mail orders should be addressed to AIChE at 25 West 45th Street, New York 36, N. Y. No "proceedings" of the Congress is expected.

## ASME Nuclear Paper High Lights

ASME papers presented during the Congress covered such fields as safety and site selection for reactors; reactor technology—including heat transfer, liquid metals, design and construction, corrosion, and fabrication; safety and shielding and remote control; reactor control and instrumentation; and reactor analysis techniques.

In all, ASME contributed 25 papers to the technical program. Some of the high lights follow:

***Reactor Technology.*** Liquid metals are replacing water, the conventional heat-transfer medium in power plants, in some atomic-power plants, it was disclosed by W. L. Fleischmann and R. F. Koenig, Knolls Atomic Power Laboratory, General Electric Company.

Sodium and an alloy, sodium-potassium, are among the liquid metals chosen for heat transfer, the speakers said. These metals will flow through a heat-transfer system at temperatures up to and above 1300 F as water flows through heating systems in many homes.

The principal advantage of sodium is its high boiling point, which means that no pressure is required in the system to hold the transfer medium at extremely high temperatures. At the same time, sodium liquefies at a temperature just under the boiling point of water, so that if it solidifies in the system, it is relatively easy to liquefy again. Also of great importance is the fact that sodium permits high rates of heat transfer and that its low viscosity makes pumping-power requirements reasonable. Its reaction to nuclear radiations is not quite as good as those of some other more expensive metals, but it is infinitely better than that of mercury, a more familiar liquid metal. Its principal disadvantage is its violent chemical reaction with water, which necessitates extra precautions and expense in guarding against leakage.

**Admiral L. L. Strauss, *left,* discusses with Karl Cohen of General Electric Company the need for more engineers and physicists in the program on the peaceful uses of atomic energy**

In another paper it was reported that a dual-cycle, boiling-water, nuclear reactor can produce steam for electrical-power generation in several economical ways. The method and reactor pressure selected determines the net station heat rate, which may vary from 10,656 to 13,117 Btu per kw-hr. The several methods of adapting this cycle for power generation were discussed by V. A. Elliott and T. Trocki of the General Electric Company.

In a reactor of this type, steam is produced by the direct transfer of heat from the nuclear fuel to the water, which serves both as a moderator and coolant in the reactor. Since the moderating effect of the water is required for continuation of the nuclear reaction, the proportion of steam and water in the reactor can be used to control its activity and therefore its heat output. Using the dual cycle overcomes the main disadvantage of the straight boiling-water reactor by providing more accurate control of the reactor without exceeding the maximum allowable steam volume in the core.

It does this by drawing hot water from the reactor core into an outside circuit where it is passed into a flash tank, or through a heat-exchanger-type boiler, and then back to the bottom of the reactor.

Thus steam generated inside the reactor passes quickly out at the top without usurping water-volume space, and removing heat from the circulating water by flashing part of it to steam, or passing it through the heat exchanger; keeps the reactor cooler; and slows up steam generation inside.

In making the studies with a flash tank in the outer water circuit, two pressure designs were considered: One having a reactor pressure of 1000 psi and flash pressure of 600 psi, and the other a reactor pressure of 600 psi and a flash pressure of 350 psi. The higher-pressure design results in a 14 per cent improvement in heat rate partly due to the higher initial pressures, and partly to the greater amount of regenerating heating possible at the higher pressure.

***Safety and Shielding.*** A gastight building made like a vertical steel tank has been designed to house the nuclear reactor and radioactive equipment required in a power plant developed by Atomic Power Development Associates, Inc., Detroit, Mich. The building was described by Walter J. McCarthy, Jr., of APDA, and Francis J. McMath of The Detroit Edison Company.

Plans for the cylindrical building specify a diameter of 84 ft and height of 150 ft, including its hemiellipsoidal bottom and hemispherical top. The cylinder and bottom of $1^1/_4$-in. steel and the top of 1-in. steel would permit an internal pressure of 33 psi at a steel temperature of 650 F.

Reasons for such a building are (1) to provide an extreme safeguard for the public in the event of a reactor accident which cannot now be foreseen, and (2) the immense responsibility that must be carried by the operator of early nuclear-power plants.

In safeguarding the reactor it became clear that design precautions which prevent the reactor from becoming "prompt critical" (going out of control) in the event of an operating error, and which prevent all possible autocatalytic effects, provide adequate

## *Some High-Light Exhibits at the 1955 International Atomic Exposition,*

Combustion Engineering, Inc.—Submarine intermediate reactor

Foster Wheeler Corporation—Aqueous homogeneous power breeder

The Babcock & Wilcox Company—Pressurized water-type steam generator

Griscom Russell Company—Nuclear steam generator

Escher Wyss, Ltd.—Closed-cycle gas turbine for nuclear power

Sylvania Electric Products, Inc.—Fuel-element assemblies

protection for the investment in the plant, and the essential basis for establishment of public safety.

At the same session, Stuart McLain and Raymond O. Brittan of the Argonne National Laboratory, pointed out that the chances of an atomic-power plant causing serious damage to the surrounding area can be reduced to zero by proper plant design, and can be held at zero by responsible management.

Plant design was considered most important because the addition of safety features after completion of a plant is seriously hampered by radioactive materials. Reactor designs of different types must be examined independently. Since consequences of reactor catastrophe are very large, safety has been given first place in the design and operation of nuclear plants.

Although a nuclear reactor will not act like an atom bomb under any circumstances, the magnitude of the hazard of radiation and radioactive materials was illustrated by a statement that "if the hazardous materials present in a single reactor should be released, it is possible that they would contaminate several hundred square miles, making the area temporarily or possibly permanently uninhabitable, though this is very unlikely."

The authors reported their experience with failures of several reactors that were designed for experimental development work. Of these only one was caused by failure of equipment, the others by operator error. The damage varied from zero to moderate, with little loss of equipment or material, except in one instance. In this instance, at the Chalk River, Ontario plant, damage was large and a year was required for cleanup because large amounts of fission products and long-lived alpha emitters were stored in the reactor as a result of long, continuous, high-power operations.

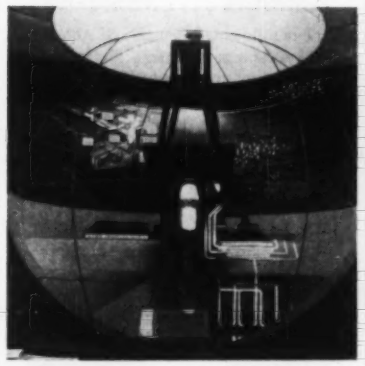
Dr. G. Hoyt Whipple of the University of Rochester Atomic Energy Project, in his paper, made a strong recommendation that maximum permissible occupational exposure to radiations in atomic-power plants should be reduced to one-tenth the limit approved by the National Committee on Radiation Protection.

Dr. Whipple said that the committee's recommendation of 0.3 roentgen per week is too high, and that proper regard for the control of radiation hazards in plant design will not only reduce the risks to employees, but will also reduce operating costs.

The committee has made it clear that its concept of a maximum permissible exposure does not entirely preclude the possibility of radiation injury to the exposed individual, or to succeeding generations, Dr. Whipple pointed out. It is the committee's intent, however, that the probability of such injuries should be so low that the risk will be readily acceptable to the average individual.

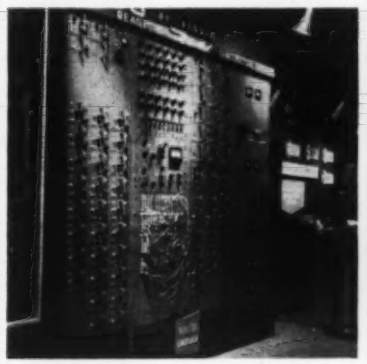
It has been found from extensive animal experimentation that repeated small doses of radiation reduce life expectancy in direct proportion to the total dose received. It also appears from those experiments that the shortening per roentgen is relatively constant among the various species of animals, at about one per cent per 100 roentgens. It has been noted that their deaths resulted from the same causes as for individuals in the unradiated control group. It has been impossible to assign radiation as the cause of death in any individual case.

## December 10 to 16, 1955, Cleveland, Ohio

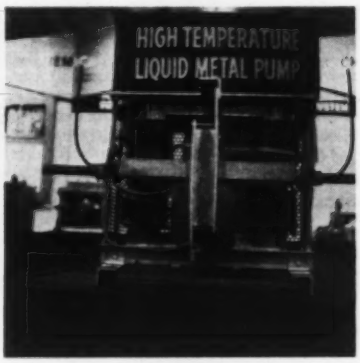


General Electric Company—Dual-cycle boiling-water reactor

Atomic Power Development Associates, Inc.—Fast-breeder reactor



Bendix Aviation Corporation—Nuclear-reactor simulator




Callery Chemical Company—High-temperature liquid-metal pump

If a man received 0.3 roentgen each week for 30 years, his total dose would be 450 roentgens. The available life-span shortening data suggest that this dose will reduce life expectancy about three years. For comparative purposes, Dr. Whipple gave life-insurance statistics that show the life expectancy of the average 30-year-old white male in the United States is reduced 0.9 year by accidents of all kinds, and 1.8 years by cancer. Thus it is evident that the risk from radiations is great enough to warrant some effort to reduce it. If the occupation exposure can be reduced to 0.03 roentgen per week, the life-expectancy reduction from a lifetime of work will be about four months, a risk that is acceptable to most people.

***Reactor Analysis Techniques.*** Education for potential nuclear engineers should "emphasize breadth rather than specialization," according to Robert J. Fritz, a General Electric Company nuclear engineer. Mr. Fritz told the Congress that undergraduate education for the designer should emphasize engineering fundamentals rather than application.

"Specialization in any particular field should be reserved for the graduate program," he advised.

"The undergraduate program should then be basically in mechanical engineering with a heavy emphasis on fundamentals, on mathematical tools to use these fundamentals, and should include studies in modern physics," Mr. Fritz pointed out.

"Colleges must recognize the needs of two classes of employees," he stated, explaining that reactor designers at General Electric must have a sound education in mechanical engineering, but can take specialized courses at G.E. He said that colleges also must provide for employees who go to companies where no provisions are made for specialized advanced courses.

The latter type of employees, he explained, would benefit from training equivalent to a five-year curriculum, or a master's degree in mechanical engineering with a minimum of six semester hours in nuclear physics.

***Reactor Controls and Instrumentation.*** Future atomic-reactor operators will not have to juggle control rods to keep reactor-power output constant, according to a General Electric Company nuclear-power reactor designer.

Samuel Untermeyer, 2nd, of the G-E Atomic Power Equipment Department, said that "there is a trend in the design of reactors toward selection of those types which will be inherently self-regulating."

Aim of such designs, he explained, is to develop reactors that respond to any power demands without the need for adjustment of control rods.

At least one such reactor already has been designed which will respond to power demands over a wide range, he reported. It is the G-E dual-cycle boiling-water reactor which will power the world's largest all-nuclear electric generating station near Chicago.

He said that, when built, this reactor will be operated under most electric load conditions without need for adjustment of control rods.

Aim of G-E designers, he said, is to banish the need for control-rod adjustments, except for start-up and shutdown.

Mr. Untermeyer used an ingenious nuclear-reactor control demonstrator, designed by him and constructed by the G-E General Engineering Laboratory, to illustrate the problem.

A "control rod" pulled out from a 6-in-sq instrument box showed how power levels constantly shift after the rod is moved any slight amount in a reactor which does not have self-regulating characteristics.

With the click of a switch the G-E engineer showed how a reactor would maintain a constant power output at any position of the control rod if self-regulating features were added.

He said that long G-E experience in building and operating atomic reactors has shown that many types of reactor instrumentation can be simplified and still be made increasingly accurate.

## ASEE Nuclear-Energy Institute at Argonne National Laboratory

The United States Atomic Energy Commission has asked the Argonne National Laboratory to conduct a Nuclear-Energy Institute during the summer of 1956, for eight weeks beginning June 20. The Institute will be sponsored jointly by the American Society for Engineering Education, the National Science Foundation, the Atomic Energy Commission, and Northwestern University. The purpose of the Institute is to provide engineering college-faculty members with information which will help them to incorporate nuclear-engineering material into their courses of instruction. Enrollment will be limited to 60 participants, and encouragement will be given to groups of two to four faculty members coming from different departments of a single institution. It is believed that the interchange of ideas among these small groups will increase the carry-over from the Institute to college-curriculums planning committees.

The Argonne National Laboratory will provide the instruction without tuition charge. The respective colleges or universities are expected to pay their Institute participants one

month's salary and this will be matched by an equal stipend from funds provided by the National Science Foundation. A travel allowance to Argonne for the participants and their families will be provided. Applicants will be notified of the amount of their travel allowance at the time of their acceptance. The dean of engineering must endorse each applicant from his institution. Application forms will be sent to all deans of engineering and additional application forms can be obtained from the Dean, Technological Institute, Northwestern University, Evanston, Ill.

Application together with the endorsement of the respective dean of engineering must be received at Northwestern University by March 1, 1956. Applicants will be advised of their acceptance by April 1, 1956.

## Proceedings of the International Conference on the Peaceful Uses of Atomic Energy Available

### *Survey of World Development of Nuclear Power for Peaceful Uses*

THE most complete survey available of the status of development of nuclear power in the world for peaceful purposes is being published by the United Nations in 16 volumes of "Proceedings of the International Conference on the Peaceful Uses of Atomic Energy."

The series will constitute the *only* official and unabridged report of the proceedings of the International Conference in Geneva, August, 1955. It will comprise all papers submitted at the Conference (about 1050), together with an edited record of the discussions concerning each paper.

#### Power Reactors

Volume 3, entitled "Power Reactors," the first of the sixteen to be printed, was issued on December 9 in English. This 400-page book priced at $7.50 contains 30 papers presented to the Geneva Conference on the peaceful uses of atomic energy and verbatim records of six sessions of the Conference. It describes reactors now operating and plans for future reactors that will produce usable power in the form of heat or electricity. The types of fuels and how they will be used are also considered in this volume which carries almost 400 illustrations.

One of the features of this volume is a catalog of all existing and planned nuclear reactors. The catalog was prepared under United Nations auspices especially for the Geneva Conference. With this summary, it is possible for the reader to compare in detail the characteristics, behavior, and the potential of specific reactors and reactor types.

Even more detail on each particular reactor type is given in the papers contained in this volume. One paper describes the USSR 5000-kw nuclear-power station which has been in operation for more than a year. This is the first description available of this reactor plant. In another paper the United States describes its prototype boiling-water reactor in comparable detail.

Every important reactor project under way by last August throughout the world is covered in this volume. The papers are divided into two groups covering: reactors now being designed for power production; and power reactor prototypes—that is, reactors that have been built or are under construction as the intermediate step between present experimental plants and the final large-scale power plants.

The descriptions of reactors for power production include four papers from France describing primarily gas-cooled reactors; seven papers from the United States describing a variety of reactors; two papers from the Netherlands describing reactors that are designed to use suspension of uranium particles as fuel; one paper from the USSR describing a boiling homogeneous reactor; and one paper from the United Kingdom describing the present project for a fast-breeder reactor to be built at Dounreay, Scotland.

Prototypes of power reactors are described in one paper from Norway; one from the United Kingdom; and eight papers from the United States.

The economics of using uranium, thorium, or plutonium as the nuclear fuel for reactors is discussed in three papers from the U.S.A., UK, and Canada, respectively.

#### Books Sold in Sets or Individually

The full series, priced at $130, or individual volumes, may be ordered from United Nations official sales agent, International Documents Service of Columbia University Press, 2960 Broadway, New York 27, N. Y. For visitors to United Nations Headquarters, the volumes will be on sale at the United Nations Bookshop; or write Sales and Circulation Section, United Nations, New York, N. Y., for your nearest agent.

All volumes of the series, in English, will be available early in 1956. (French editions will be available early in 1956; Spanish and Russian during 1956.)

Each of the volumes is bound in a blue cloth cover, stamped with a design simulating the electron orbits around the nucleus of an atom. Superimposed on this gold-stamped design is the title of the volume and the United Nations emblem in white. Each volume has a dust jacket.

Editorial preparation of the material for the volumes was done by a team of scientific secretaries and other personnel under Prof. Walter Whitman, Secretary General of the International Conference on the Peaceful Uses of Atomic Energy. The United Nations published them, with the printing carried out by its publishing services.

Preliminary work leading to the publication of the volumes was begun even before the opening of the International Conference on the Peaceful Uses of Atomic Energy which met in Geneva from August 8 to 20 of last year. Actual editorial work, however, was not begun until after the Conference. Thus only four months have elapsed before publication of the first volume of the Proceedings.

## ASME Manuals and Annuals Available

THE following Manuals and Annuals are available to members of the Society. One copy of any or all of these publications may be obtained by writing to the ASME Order Department. Please use code and name of each publication.

| | |
|---|---|
| MM 1 | Certificate of Incorporation, Constitution, By-Laws, and Rules |
| MM 2 | Know Your Society |
| MS 4 | An ASME Paper—Its Preparation |
| MS 61 | Citizenship and Participation in Public Affairs |
| AC 1 | Report of Committees to the Council |
| AC 10 | Personnel of Council, Boards, and Committees |
| AM 1 | Membership List—Alphabetical and Geographical (Biennial — odd-numbered years) |
| AM 4 | Members List—Listed by Companies (Biennial—even-numbered years) ($2 each) |
| AM 5 | Indexes to ASME Papers and Publications (Published annually in January issue of Transactions) |
| (AM 2) | Council Report to Members (Published annually in January issue of MECHANICAL ENGINEERING) |
| AM 3 | Catalog of Publications (also included in Mechanical Catalog) |

Other publications not prepared by ASME are available to members on request.

Charter and History of United Engineering Trustees, Inc.

United Engineering Trustees Annual Reports of Engineering Societies Library and Engineering Foundation

Engineers' Council for Professional Development Annual Report ($1 each)

Engineers Joint Council Annual Report

## People

***Honors and Awards.*** CLIFFORD C. FURNAS, Mem. ASME, Chancellor of the University of Buffalo, N. Y., assumed the office of Assistant Secretary of Defense (Research and Development) on December 5. He was appointed to his new position by President Eisenhower on Nov. 22, 1955.

R. LIVINGSTON IRELAND, Mem. ASME, chairman of the Executive Committee of Pittsburgh Consolidated Coal Company, Cleveland, Ohio,

will receive the Erskine Ramsay Gold Medal for coal mining during the annual meeting of the American Institute of Mining and Metallurgical Engineers, to be held Feb. 19–23, at the Hotel Statler, New York, N. Y.

Citations were presented to outstanding engineering alumni of the University of Pennsylvania on the occasion of the Centennial Celebration of Engineering Education at the University. The following members of ASME were among those honored: HENRY B. BRYANS, WALTER L. FLEISHER, S. LOGAN KERR, Fellow ASME; and D. ROBERT YARNALL, past-president and Hon. Mem. ASME.

LEE N. GULICK, Mem. ASME, director of the school of mechanical engineering, who spoke at the Engineering Alumni Society's annual dinner, held at the University Museum, traced the history of engineering education at the University of Pennsylvania.

The Philadelphia Section of ASME cosponsored the Centennial Symposium on Modern Engineering, which was held in the afternoon preceding the dinner and was attended by some 400 engineers.

FELIX E. WORMSER, Assistant Secretary of the Interior, has been named 1956 recipient of the Egleston Medal, Columbia University's highest award for "distinguished engineering achievement." The medal will be presented on March 14 at a dinner at the Waldorf-Astoria Hotel, New York, N. Y.

MARS G. FONTANA, Assoc. Mem. ASME, professor of metallurgical engineering, Ohio State University, Columbus, Ohio, has been selected as the 1956 recipient of the Speller Award by the National Association of Corrosion Engineers. The award will be presented at the annual banquet to be held at Hotel Statler, New York, N. Y., during the NACE twelfth annual conference, March 12–16.

***New Officers.*** H. THOMAS HALLOWELL, JR., president, Standard Pressed Steel Company, Jenkintown, Pa., has been elected president of the American Standards Association. He took office on January 1, for a one-year term. VAN H. LEICHLITER, vice-president of operations of American Steel and Wire Division, United States Steel Corporation, Cleveland, Ohio, was elected vice-president of ASA. R. M. GATES, past-president and Hon. Mem. ASME, president, Air Preheater Corporation, New York, N. Y., was re-elected to the ASA board of directors to serve a three-year term, representing the ASME.

The National Association of Corrosion Engineers elected W. F. FAIR, JR., Tar Products Division, Coppers Company, Inc., Pittsburgh, Pa., president; W. H. STEWART, Sun Pipe Line Company, Beaumont, Texas, vice-president; and R. A. BRANNON, Humble Pipe Line Company, Houston, Texas, treasurer for 1956–1957.

EDWARD R. SHARP, director of the Lewis Flight Propulsion Laboratory of the National Advisory Committee for Aeronautics, was elected president of the Institute of the Aeronautical Sciences for 1956. He was installed January 23 at the IAS Honors Night Dinner held in New York, N. Y.

**Stephen Juhasz, Mem. ASME, executive editor, *Applied Mechanics Reviews,* discusses with the *Reviews* staff an exhibit prepared for the annual Open House held at Southwest Research Institute, San Antonio, Texas, where the editorial office of the magazine is now located. The exhibit attracted wide attention and described the huge variety of literature searching, reviewing, and editing which forms an integral part of the *Reviews* operation. From *left to right,* starting with Dr. Juhasz, are Jane Demmer, Lillian Bosch, Martin Goland, Mem. ASME, editor; Marylyn Ingersoll, Norman H. Abramson, associate editor, who was visiting from the University of Texas; and Estelle Gindorf. *AMR,* a publication of ASME, is now going into its ninth year. Subscription rates to the *Reviews* are as follows: $25 a year or $2.50 a copy; to members of ASME and co-operating societies $10 a year or $1 a copy.**

**Rudolph Plank, *center,* visiting professor of mechanical engineering at Columbia University and internationally famous for his research and contributions in the field of refrigeration and air conditioning, inspects a Refrigeration Test Stand while touring Worthington Corporation's Research Laboratories at Harrison, N. J. Carl F. Kayan, *right,* Mem. ASME, professor and executive officer of the mechanical-engineering department of Columbia University, accompanied Dr. Plank on his recent tour. At *left,* Worthington Corporation's Director of Research, Hellmuth Walter, explains major features of the refrigeration test equipment.**

The spillway dam at Bonneville Dam 37 miles east of Portland, Ore., to be visited during the 1956 ASME Spring Meeting, is located in the main channel of the Columbia River. The entire Bonneville Dam project consists of a powerhouse, navigation lock, and fishways, in addition to the spillway dam. The Bonneville Dam was built at a cost of approximately $100 million under the supervision of the War Department, U. S. Army Engineers.

# 1956 ASME Spring Meeting to Be Held in Portland, Ore., March 18–21

## Headquarters: The Multnomah Hotel
## Program lists 16 technical sessions

The program for the 1956 Spring Meeting of The American Society of Mechanical Engineers, which will be held at the Multnomah Hotel, in Portland, Ore., announces 16 technical sessions of importance.

The program takes on local flavor, evolving around the wood industries, with several sessions to be devoted to processing, waste utilization, pulp and paper, fabrication, and material handling of wood and wood products. There will be three sessions for the discussion of nuclear engineering. The program planners predict that there will be much new information to interest the members and their associates at these sessions covering other fields, including material handling in airplane manufacture, power, fuels, gas turbines, and metal processing.

The tentative program follows:

### MONDAY, MARCH 19

**8:00 a.m.**

Registration

**9:30 a.m.**

Wood Industries (I)—Safety

*Sawmilling*

**Power Requirements for Sawing Redwood Cants at Different Speeds With Seven-Ft Diam Band**[1]

**Dry-Kiln Design**[1]

**Log Debarking and the Economics of Debarking**[1]

[1] Paper not available—see box on page 195.

**9:30 a.m.**

Nuclear Engineering (I)

**Design of Graphite-Moderated Power Reactors**[1]

**Fuel Elements for Nuclear Reactors**[1]

**The Materials-Testing Reactor Operating Characteristics and Experimental Testing**[1]

**9:30 a.m.**

Fuels (I)—Power (I)

**Waste-Wood Burning Using Spreader Stokers**[1]

**Experience in Operating Spreader Stokers Using Waste-Wood Fuels**[1]

**Process and Product Improvements to Be Anticipated With Natural Gas**[1]

**12:15 p.m.**

President's Luncheon

Toastmaster: *Byron T. McMinn*, Vice-President Region VII; University of Washington, Seattle, Wash.

Address: *Joseph W. Barker*, ASME President

**2:30 p.m.**

Wood Industries (II)

*Wood-Residue Utilization*

**Radio-Frequency Gluing as Applied to the Wood Industries**[1]

**Design, Manufacturing Methods, and Applications of Glued-Laminated Structural Members**[1]

**Lateral Tests on Full-Scale Lumber and Plywood-Sheathed Roof Diaphragms**[1]

**2:30 p.m.**

Nuclear Engineering (II-A)—Power (II-A)

**Meteorological Factors in Site Selection**[1]

**Process-Engineering Problems in the Hanford Separations Plants**[1]

**2:30 p.m.**

Power (II-B)—Hydraulic—Nuclear Engineering (II-B)

**Hydropower in the Northwest**[1]

**Integration of Steam and Hydropower in Northern California**[1]

**An Economic Appraisal of Nuclear Versus Hydropower Development in the Pacific Northwest**[1]

**8:00 p.m.**

Junior—Management—Education

**Building a Professional Future**[1]

**Professional Development—The Importance of Early Planning**[1]

**The Professional Development of the Young Engineer**[1]

### TUESDAY, MARCH 20

**8:00 a.m.**

Registration

**9:30 a.m.**

Wood Industries (III)—Air-Pollution Controls

*Pulp and Paper*

**Particle-Board Manufacture (Mechanization)**[1]

**Suspension Drying of Sawdust**[1]

**Air and Stream-Pollution Problems of Pulp and Paper Mills**[1]

**9:30 a.m.**

Gas Turbine Power (I-A)

**A Pod-Mounted Gas-Turbine-Driven Auxiliary Power Unit**[1]

**The Versatile Gas Turbine**[1]

**9:30 a.m.**

Power (III)—Fuels (II)—Gas Turbine Power (I-B)

**The Impact of Natural Gas on the Economy of the Pacific Northwest**[1]

**The First Commercial Steam Generator at Supercritical Pressure**[1]

**Portable 5000-KW Railway and Skid-Mounted Gas-Turbine Power Plants**[1]

**2:30 p.m.**

Heat Transfer

**Through Permeable Substances**[1]

**Flow Through Annular Orifices**[1]

**Selection of Optimum Configurations for a Heat Exchanger With One Dominating Film Resistance**[1]

**2:30 p.m.**

Materials Handling (I)

**Modern Material Handling as Employed by the Boeing Airplane Company Seattle Division**, by *Bayne Lamb*, Boeing Airplane Co. (Paper No. 56—S-5)

**Prediction of Delay in Material-Handling Systems**[1]

**6:30 p.m.**

Banquet

Address: *W. F. McCulloch*, School of Forestry, Oregon State College, Corvallis, Ore.

Business Dress

## Free Coupons to ASME Members

EACH year the Society sends its members a book of ten free coupons for technical papers. These are sent with the annual-dues statement in August and are valid until the end of the following calendar year. The expiration date appears on each coupon. Unless the date is observed, the Society cannot determine the extent of its obligation to supply separate copies of technical papers during availability periods. We know you will understand and we appreciate your co-operation.

### Registration Schedule

Monday, March 19, 8:00 a.m. to 8:00 p.m.

Tuesday, March 20, 8:00 a.m. to 3:00 p.m.

Wednesday, March 21, 8:00 a.m. to 3:00 p.m.

## WEDNESDAY, MARCH 21

**8:00 a.m.**

Registration

**9:30 a.m.**

Materials Handling (II)

**Outstanding Material-Handling Practices in the Pulp and Paper Industry on the West Coast,** by *F. D. Helversen,* Crown Zellerbach Corp. (Paper No. 56—S-1)

**Handling Timber With the Fork-Lift Truck and Material Carrier,** by *Norman D. Thompson,* Gerlinger Carrier Co. (Paper No. 56—S-4)

**9:30 a.m.**

Metal Processing (I)—Production Engineering (I)

**Determination of the Instantaneous Cutting Forces in Milling**[1]

**Progress in the Machining of Integrally Stiffened Structures From Plate**[1]

**A Review of the Metal-Cutting Analyses of the Past Hundred Years**[1]

[1] Paper not available—see box on this page.

### Orders for Technical Papers

ONLY copies of *numbered* ASME papers will be available. Some of these papers may not be available in time to permit your receiving them in advance of the Meeting. Your order will be mailed only when the complete order can be filled unless you request that all papers available ten days before the Meeting be mailed at that time. Please order only by paper *number;* otherwise the order will be returned. The final listing of available technical papers will be found in the issue of MECHANICAL ENGINEERING containing an account of the Meeting.

Copies of ASME papers may be obtained by writing to the ASME Order Department, 29 West 39th Street, New York 18, N. Y. Papers are priced at 25 cents each to members; 50 cents to nonmembers. Payment may be made by check, U. S. postage stamps, free coupons, or coupons which may be purchased from the Society. The coupons in lots of ten, are $2 for members; $4 for nonmembers.

*Copies of unnumbered papers,* listed in the program, *are not available* because the review of these manuscripts had not been completed when the program went to press. The author's name and paper number will appear with paper title in the final program (final program available only at Meeting) as well as the issue of MECHANICAL ENGINEERING containing an account of the Meeting, if the paper has been recommended for publication in pamphlet form.

**2:30 p.m.**

Materials Handling (III)

**High-Pressure Pneumatic Conveying in the Lumber Industry,** by *I. A. Rader,* Rader Pneumatics, Inc. (Paper No. 56—S-3)

**The Design of Overhanging Attachments for Track-Type Tractors,** by *Robert C. Shoemaker,* Hyster Co. (Paper No. 56—S-2)

**The Carrier Method of Handling as Applied in the Steel Industry**[1]

**2:30 p.m.**

Metal Processing (II)—Production Engineering (II)—Metals Engineering

**Investigation of Strength of Copper-Brazed Joints**[1]

**High-Flying Ti**[1]

### Inspection Trips

Those who attend the meeting will have several interesting field trips to choose from. On Monday, March 19, a dinner and evening trip to Mount Hood are tentatively planned. The Hyster Corporation and Crown Zellerbach Corporation will be visited on Tuesday, March 20. On Wednesday, an afternoon trip and dinner may be taken to either the Weyerhauser Timber Company at Longview or The Dalles Dam.

### Indexes to ASME Papers and Publications Available in New Annual

INDEXES to ASME Papers and Publications, published annually in the January issue of Transactions, is now available in a new annual known as AM 5.

For the convenience of the members of the Society who would be interested in ordering a copy of AM 5, a business reply card, post-free, appears in the advertising pages of this issue of the magazine.

Another annual Catalog of Publications, AM 3, describes ASME publications listed in AM 5. The Catalog of Publications also is included in the Mechanical Catalog.

# Fourth Annual Engineering Management Conference to Commemorate Birth of Frederick W. Taylor

"Improving Management With and for Engineers," theme of conference to be held in St. Louis, Mo., March 14–15.

The Fourth Annual Conference of the Management Division of The American Society of Mechanical Engineers will be held at the Hotel Statler, St. Louis, Mo., March 14–15, 1956. The program, which promises to be both interesting and informative, is the result of joint efforts by the Management Division and the St. Louis Section of ASME in cooperation with the Management Committee and St. Louis Section of the American Institute of Electrical Engineers.

In addition to carrying out the conference theme, Improving Management With and for Engineers, tribute will be paid to Frederick Winslow Taylor, the "Father of Scientific Management," celebrating the one-hundredth anniversary of his birth, March 20, 1856.

Four technical sessions are scheduled to elaborate on the Conference theme. An outline of these sessions follows.

## WEDNESDAY, MARCH 14

**9:00 a.m.** Session 1

Effective Use of Engineering Skill

**Design,** by *B. C. Boulton,* McDonnell Aircraft

**Production,** by *Roger J. Emmert,* General Motors Manufacturing Staff

**Research,** by *H. R. Kemmerer,* Shell Oil Co.

**12:15 p.m.**

Luncheon

**2:30 p.m.** Session 2

Development of the Engineer as a Manager

**Developing the Creative Instinct,** by *John R. Brand,* E. I. du Pont de Nemours Co., Inc.

**Creating a Future in the World of Tomorrow,** by *R. P. Kroon,* Westinghouse Electric Corp.

**The Engineer in a Professional Status,** by *N. T. Veatch and R. D. Woodson,* Black and Veatch, consulting engineers.

**6:30 p.m.**

Banquet

## THURSDAY, MARCH 15

**9:30 a.m.** Session 3

The Engineer Makes His Contribution to Management

**Applying Linear Programming to Inventory Planning in a Seasonal Market,** by *Donald A. Moffett,* Methods Engineering Council

**Equipment-Replacements Economics,** by *Philip A. Scheuble, Jr.,* A. O. Smith Corp.

**Application of Latest Developments in Engineering in Your Own Field,** by *Theodore Thoren,* Thompson Products, Inc.

**12:15 p.m.**

Luncheon

**2:30 p.m.** Session 4

Industry Should Share in the Training of the Engineer

**The Art of Applying Science,** by *Leroy E. Lattin,* Southwestern Bell Telephone Co.

**The Training Stage After Graduation,** by *George D. Lobingier,* Westinghouse Electric Corp.

## ASME Coming Events

**March 14–16**

ASME Aviation Division Conference, Hotel Statler, Los Angeles, Calif.

(*Final date for submitting papers was Nov. 1, 1955*)

**March 14–15**

ASME Engineering Management Conference, Hotel Statler, St. Louis, Mo.

(*Final date for submitting papers was Nov. 1, 1955*)

(*Continued on next page*)

*(ASME Coming Events—Continued)*

**March 18–21**

ASME Spring Meeting, Multnomah Hotel, Portland, Ore.
*(Final date for submitting papers was Nov. 1, 1955)*

**March 26–28**

ASME Instruments and Regulators Division Conference, Princeton University, Princeton, N. J.
*(Final date for submitting papers was Nov. 1, 1955)*

**April 1–5**

ASME Oil and Gas Power Division Conference, Jung Hotel, New Orleans, La.
*(Final date for submitting papers was Dec. 1, 1955)*

**April 10–11**

ASME Machine Design Division Conference, Bancroft Hotel, Worcester, Mass.
*(Final date for submitting papers was Dec. 1, 1955)*

**April 16–17**

ASME Gas Turbine Power Division Conference, Hotel Statler, Washington, D. C.
*(Final date for submitting papers was Dec. 1, 1955)*

**April 26–27**

Eleventh Annual ASME-SAM Management-Engineering Conference, Hotel Statler, New York, N. Y.

**May 8–11**

ASME Metals Engineering-AWS Conference, Hotel Statler, Buffalo, N. Y.
*(Final date for submitting papers was Dec. 31, 1955)*

**May 23–25**

ASME-EIC Meeting, Mount Royal Hotel, Montreal, Que., Can.
*(Final date for submitting papers was Dec. 31, 1955)*

**June 11–13**

ASME Applied Mechanics Western Division Conference, California Institute of Technology, Pasadena, Calif.
*(Papers being accepted until program is filled)*

**June 14–16**

ASME Applied Mechanics Division Conference, University of Illinois, Urbana, Ill.
*(Final date for submitting papers was Feb. 1, 1956)*

**June 17–21**

ASME Semi-Annual Meeting, Hotel Statler, Cleveland, Ohio
*(Final date for submitting papers was Feb. 1, 1956)*

**Sept. 10–12**

ASME Fall Meeting, Cosmopolitan Hotel, Denver, Colo.
*(Final date for submitting papers—May 1, 1956)*

**Sept. 17–21**

ASME Instruments and Regulators Division and Instrument Society of America Exhibit and Joint Conference, Coliseum, New York, N. Y.
*(Final date for submitting papers—May 1, 1956)*

**Sept. 23–26**

ASME Petroleum-Mechanical Engineering Conference, Conrad Hilton Hotel, Dallas, Texas
*(Final date for submitting papers—May 1, 1956)*

**Oct. 8–10**

ASME-ASLE Third Lubrication Conference, Chalfonte-Haddon Hall, Atlantic City, N. J.
*(Final date for submitting papers—June 1, 1956)*

**Oct. 24–25**

ASME-AIME Joint Fuels Conference, Sheraton-Park Hotel, Washington, D. C.
*(Final date for submitting papers—June 1, 1956)*

**Nov. 25–30**

ASME Annual Meeting, Hotel Statler, New York, N. Y.
*(Final date for submitting papers—July 1, 1956)*
*(For Meetings of Other Societies, see page 198)*

## Schedule 1956 RAC Meetings

| *Date* | *Day* | *Place* | *Hotel* | *Region* |
|---|---|---|---|---|
| March 24–25 (Student Conference March 23–24) | Sat.–Sun. | Clemson, S. C. | Clemson House | IV |
| March 22–23 | Thurs.–Fri. | Wilmington, Del. | Hotel du Pont | III |
| April 13–14 | Fri.–Sat. | Albuquerque, N. Mex. | Alvarado Hotel | VIII |
| April 9–10 | Mon.–Tues. | Canton, Ohio | St. Francis | V |
| April 20–21 | Fri.–Sat. | Honolulu, T. H. | The Reef | VII |
| April 30–May 1 | Mon.–Tues. | Poughkeepsie, N. Y. | Nelson House | II |
| May 4–5 | Fri.–Sat.[1] | Durham, N. H. | Rockingham | I |
| April 27–28 | Fri.–Sat. | Chicago, Ill. | Edgewater Beach | VI |

[1] Saturday meeting, University of New Hampshire

Palm Sunday, March 25; Good Friday, March 30; and Easter Sunday, April 1.

# ASME Aviation Conference Plans Announced—Los Angeles Is Location; March 14–16 Is Date

THE Aviation Division of The American Society of Mechanical Engineers, working jointly with the ASME Instruments and Regulators Division, the American Rocket Society, and the Institute of the Aeronautical Sciences, is completing plans for an Aviation Conference to be held at the Hotel Statler, Los Angeles, Calif., March 14–16. The technical program, composed of 22 sessions, has been built around two general themes, "The Thermal Thicket" and "Air Cargo and Air Logistics."

In developing the Thermal Thicket theme, problems pertaining to structures, human factors, safety concepts, accessories, high temperature, and propulsion will be discussed. The Air-Cargo and Air-Logistics theme will be carried out from a military as well as a commercial point of view. The latter program will be highlighted by a field trip to the C-133 Cargo Transport Plant of the Douglas Aircraft Company, Inc., at Long Beach, Calif.

The tentative arrangement of the program follows:

### WEDNESDAY, MARCH 14

**9:30 a.m.**

### The Thermal Thicket: Structures—Materials

Chairman: *Leo Schapiro*, Douglas Aircraft Co., Santa Monica, Calif.

Vice-Chairman: *John V. Long*, Solar Aircraft Co., San Diego, Calif.

**Aluminum Alloys for Elevated-Temperature Service,** by *E. H. Dix*, Aluminum Co. of America

**The Application of a New Structural Mass to Compare Titanium Alloys With Other Materials in Air-Frame Structures,** by *S. Gordon and L. R. Jackson*, Battelle Memorial Institute

**9:30 a.m.**

### The Thermal Thicket: Human Factors

Chairman: *Col. A. P. Gagge*, USAF, Deputy Commander—Resources, Air Force Office of Scientific Research and Development Command, Baltimore, Md.

Vice-Chairman: *Donald E. Brimley*, Douglas Aircraft Co., Inc., Long Beach, Calif.

Introductory Remarks, by *Lieut. Col. Frank Everest*, pilot of the X-2

**Description and Prediction of Human Response to Aircraft Thermal Environments,** by *Craig L. Taylor*, UCLA

**Ventilated Clothing as a Protection Against Heat Exposure,** by *Paul W. Webb*, Aeronautical Metallurgical Laboratory, WADC

**Human Problems in the Development of the F-102 Cockpit,** by *W. H. Reineking*, Human Factors, Convair

**9:30 a.m.**

### Air Cargo

*Session 1*

Chairman: *L. R. Hackney*, Executive Committee Member, ASME Aviation Division

Vice-Chairman: *E. W. Robischon*, IAS Western Region Manager

*Commercial—Market Analysis*

**Civil Air Cargo; Its Routes and Volumes,** by *Joseph D. Blait*, Civil Aeronautics Administration

### Panel: Air-Cargo's Outlook and Its Problems

*L. B. Ashenbeck*, Douglas Aircraft Company, Inc., Santa Monica, Calif.

*Harry H. Carter*,[1] Boeing Airplane Company, Seattle, Wash.

*W. H. Arata, Jr.*,[1] Fairchild Aircraft Division, Hagerstown, Md.

*R. K. Waldo*, Convair Division of General Dynamics Corp., San Diego, Calif.

**12:00 noon**

### Luncheon

**2:30 p.m.**

### The Thermal Thicket: Structures—Optimum Air Frame Structures

**Optimum Stresses of Structural Elements at Elevated Temperatures,** by *A. Schnitt, M. A. Brull, and H. S. Wolko*, Bell Aircraft Corp.

**Thermostructural Efficiencies of Compression Elements and Materials,** by *George Gerard*, New York University

**Weight-Efficiency Analysis of Thin-Wing Construction,** by *Roger A. Anderson*, Langley Aeronautical Laboratories, NACA

**2:30 p.m.**

### Air Cargo

*Session 2*

Chairman: *E. C. Mitchell*,[1] United Air Lines, Inc., Denver, Colo.

Vice-Chairman: *P. T. Albert*, Flying Tiger Line, Burbank, Calif.

*Commercial—Application*

**Flying the U. S. Mail—Today and Tomorrow,** by *E. George Siedle*, Bureau of Transportation, Post Office Department, Washington, D. C.

[1] Pending acceptance.

**Air-Freight's Iron Curtain,** by *Thomas J. Harris,* American Airlines, Inc., New York, N. Y.

2:30 p.m.

### The Thermal Thicket: Accessories (I)

**A Comparison of Hydraulic and Pneumatic Energy as a Means of Powering Aircraft Accessories,** by *E. I. Brown,* Vickers, Inc.

**An Evaluation of Electrical Power Requirements for Copilot's Instrumentation,** by *Ernie Kotnik,* Convair, San Diego, Calif.

**High-Temperature Problems of Electrical Equipment,** by *Leonard Lyons,* consulting engineer

2:30 p.m.

### IRD Session on Aviation Instrumentation (I)

Chairman: *Paul Farrara,* Convair Division, General Dynamics Corp., San Diego, Calif.

**The Development of a Stabilized Platform to Mount on a Nonrigid Airship Base,** by *A. H. Williams,* Goodyear Aircraft Corp., Akron, Ohio

**Recent Advances in Miniature Instrument-Bearing Technology,** by *O. M. Bergethon,* New Hampshire Ball Bearings, Inc., Peterborough, N. H.

**Controlled Gyro Tumbling by Means of a High-Angle Gimbal Stop,** by *Louis Curdo,* General Electric Company, West Lynn, Mass.

8:00 p.m.

### The Thermal Thicket: Structures—General Meeting

Chairman: *Brig. Gen. Marvin C. Demler,* USAF, Assistant Deputy Commander, Technical Operations, Air Research and Development Command, Baltimore, Md.

Vice-Chairman: *George T. Hayes,* Stanford Research Institute, Washington, D. C.

**The Advance in the State of the Art,** by *R. C. Sebold,* Convair

**Fighter-Type Aircraft,** by *George Schairer,* Boeing Airplane Co.

## THURSDAY, MARCH 15

9:30 a.m.

### The Thermal Thicket: Propulsion

Chairman: *Carl A. Weise,* Douglas Aircraft Co., Inc., Santa Monica, Calif.

Vice-Chairman: *Harry Drell,* Lockheed Aircraft Corp., Burbank, Calif.

**What We Need in Engines,** by *Welko Gasich,* Northrup Aircraft

**Performance and Design Considerations for Turbojet Engines Operating in the Thermal-Barrier Region,** by *R. E. Weiler,* Westinghouse Electric Corp.

**The Effect of Supersonic Flight on Turbojet-Engine Design,** by *W. L. Durkin* and *D. C. Goldberg,* Westinghouse Electric Corp.

9:30 a.m.

### The Thermal Thicket: Structures—Factor of Safety Concepts

Chairman: *H. J. McBrearty,* Lockheed Aircraft Corp., Burbank, Calif.

Vice-Chairman: *George N. Mangurian,* Northrup Aircraft Co., Inc., Hawthorne, Calif.

**Design Criteria for Heated Structures,** by *Robert Goldin,* Bell Aircraft Corp.

**Discussion of Safety-Factor Requirements on Supersonic Aircraft Structures Subjected to Thermal Effects,** by *George M. Goldman,* Advanced Development Group, ANCO, Stratford, Conn.

**Some Weight Penalties Associated With Thermo Flight,** by *James W. Mar,* Massachusetts Institute of Technology

9:30 a.m.

### The Thermal Thicket: Accessories (II)

Chairman: *Roberg Cornog,* The Ramo-Wooldridge Corp.

**Drag-Turbines Performance,** by *Eric Balje,* Hydro-Aire, Inc.

**Hero's Aeolipile Comes of Age in Accessory Power for Missiles,** by *Ben Ettelson,* American Machine and Foundary

**Ramjet Controls for High-Supersonic Flight,** by *A. J. Kriner,* Marquardt Aircraft Corp.

9:30 a.m.

### Air Cargo
*Session 3*

Chairman: *C. J. Rausch,* Lockheed Aircraft Corp., Burbank, Calif.
Vice-Chairman: *Clark Henderson,* Stanford Research Institute, Stanford, Calif.

*Military—Research Forecast and Application*

**Capital Expenditures for Large Transport Aircraft—Factors Bearing on The Military Decision,** by *Samuel E. Eastman,* The Rand Corp., Santa Monica, Calif.

Title to be announced, by *Brig. Gen. Raymond L. Winn,* USAF, Air Materiel Command, Wright-Patterson AFB, Ohio

12:00 noon

Luncheon

2:30 p.m.

### Air Cargo
*Session 4*

Chairman: *H. O. Olson,* Douglas Aircraft Co., Inc., Santa Monica, Calif.

*Military—Application*

**Military Air-Transport Service Role in the Intercontinental Movement of Supplies,** *Brig. Gen. Don O. Darrow,* USAF, Deputy Chief of Staff, Materiel, Hq. MATS, Andrews AFB, Md.

**The Large Jet-Seaplane Transport and Its Military Uses,** by *Chauncey F. Bell,* The Glenn L. Martin Company, Baltimore, Md.

Title to be announced, by *Lieut. Gen. W. H. Tunner,*[1] USAF, Commander-in-Chief, United States Air Forces in Europe, Wiesbaden, Germany

2:30 p.m.

### ARS Session—Earth Satellites

**Chairman:** *William Bollay,* Aerophysics Development Corp., Santa Monica, Calif.

Vice-Chairman: *T. Carney,* Hughes Aircraft Co., Culver City, Calif.

**Scientific Aspects of the Satellite Program,** by *W. H. Pickering,* California Institute of Technology, Pasadena, Calif.

**Project Vanguard—The IGY Earth Satellite,** by *F. R. Furth,* Rear Admiral, USN, Naval Research Laboratory, Washington, D. C.

**Feasibility of Orbiting Shaped Charge Particles and Their Scientific Value,** by *A. W. Ehler,* Aerophysics Development Corp., Santa Monica, Calif.

2:30 p.m.

### IRD Session on Aviation Instrumentation (II)

Chairman: *D. C. Maddox,* G. M. Giannini & Co., Inc., Pasadena, Calif.

**Research and Development Through Uninhibited Thinking,** by *G. W. Hoover,* CDR, USN Office of Naval Research, Washington, D. C.

**Development and Evaluation of an Icing Indicator,** by *S. W. Churchill, M. P. Moyle,* University of Michigan, Ann Arbor, Mich.; *Myron Tribus* and *H. E. Stubbs,* University of California, Los Angeles, Calif.

2:30 p.m.

### The Thermal Thicket: Structure—Testing Techniques

**Aircraft Structural Testing Techniques at Elevated Temperatures,** by *Robert C. Brouns,* USAF, and *Richard B. Baird,* Aircraft Laboratory, WADC, Wright-Patterson Air Force Base, Ohio

**Some NACA Research on the Effect of Transient Heating on Aircraft Structures,** by *John E. Duberg,* Langley Aeronautical Laboratory, NACA

**Utilization of Solar Furnaces in High-Temperature Research,** by *Pol Duwez,* California Institute of Technology, Pasadena, Calif.

6:30 p.m.

Banquet

[1] Pending acceptance.

## FRIDAY, MARCH 16

9:30 a.m.

### ARS Session—High-Temperature Design Problems

Chairman: *H. Schuerch,* Aerophysics Development Corp., Santa Monica, Calif.

Vice-Chairman: *Eldon Knuth,* Aerophysics Development Corp., Santa Monica, Calif.

**Is There a Thermal Barrier for Supersonic Ramjet Tail Pipes?** by *W. Unterberg,* Marquardt Aircraft Corp., Van Nuys, Calif.

**Structure Research at Heating Rates With Free-Flight Rocket Vehicles,** by *I. Zackerman,* Aerophysics Development Corp., Santa Monica, Calif.

**Heat-Transfer Problems in Solid Propellant Rocket Design,** by *T. T. Omari,* Aerojet General Corp., Azusa, Calif.

9:30 a.m.

### IRD Session on Aviation Instrumentation (III)

Chairman: *J. M. Heldack,* General Electric Company, Los Angeles, Calif.

**Modernization of Airborne Electronic Equipment by the Use of Transistors,** by *J. W. Lacy and P. D. Davis, Jr.,* Texas Instruments, Inc., Dallas, Texas

**Mass Flowmeter for In-Flight Refueling,** by *C. F. Taylor,* General Electric Company, West Lynn, Mass.

9:30 a.m.

### Air Cargo
*Session 5*

Field trip to inspect the Douglas C-133 Cargo Transport Long Beach Plant, Douglas Aircraft Company, Inc., Long Beach, Calif.

2:30 p.m.

### ARS Session—High-Temperature Application of Nonmetallic Materials

Chairman: *Frank Marion,* Grand Central Rocket Co., Redlands, Calif.

Vice-Chairman: *W. Schaafma,* Grand Central Rocket Co., Redlands, Calif.

**Use of Graphite—High-Temperature Application,** by *L. D. Loch,* Battelle Memorial Institute, Columbus, Ohio

**High-Temperature Short-Lived Plastic Laminates,** by *G. Dodson,* H. I. Thompson Co., Los Angeles, Calif.

## ASME Receives Letter of Appreciation From State Department

As a result of the ASME tour conducted by Brig. Gen. S. E. Reimel, USA (ret.) for two Russian engineers who visited the United States, Nov. 14–30, 1955 (see MECHANICAL ENGINEERING, January, 1956, page 108), the Society received from Livingston T. Merchant, Assistant Secretary, State Department, Washington, D. C., the following letter of appreciation:

Dear Colonel Davies:

I wish to express my appreciation for the time, effort and expense undertaken by The American Society of Mechanical Engineers in sponsoring the recent visit of Soviet Automation experts. I understand that the Society's role as host was doubly complicated by the fact that the Seventy-Fifth Annual Meeting of the Society occurred at the same time and by the fact that this visit touched on new areas in the uncertain field of East-West contacts.

It is deserving of recognition that despite these difficulties the job has been well done. Your personal efforts and those of the Society constitute, in my opinion, a significant public service.

# ASME Machine Design Division to Sponsor Design-Engineering Conference in Philadelphia, May 14–17

A CONFERENCE to study industry's problems in design engineering has been announced by the Machine Design Division of The American Society of Mechanical Engineers, sponsor of the event.

It will be held at Convention Hall, Philadelphia, Pa., May 14–17, concurrently with the First Design Engineering Show, produced by Clapp & Poliak, Inc., New York, N. Y., exposition-management firm.

"There is an urgent need for a national conference to consider current problems in design engineering, including the human relations of design engineering," said Robert M. Conklin, chief, mechanical-engineering division, Battelle Memorial Institute, Columbus, Ohio, and chairman of the ASME Machine Design Division.

"Each new development in automatic, high-speed production equipment presents scores of design problems. As design engineering improves, the public is benefited by new products, better products, and less expensive products. We hope to stimulate industrial thinking and planning for better design engineering by this national conference on the subject," Mr. Conklin said.

Four editors of leading publications in the engineering-design field have been named by the ASME as an auxiliary papers committee to draft a program for the four-day meeting.

They are Colin Carmichael, *Machine Design;* T. C. DuMond, *Materials and Methods;* George F. Nordenholt, *Product Engineering*, and Frank J. Oliver, *Electrical Manufacturing*.

The program will lay stress on the need for attracting new men to the field, training them, and making adequate provisions for rewarding outstanding achievements. Other subjects will include cost reduction as an important element in design, selection of engineering materials, and the effect of the trend toward miniaturization.

According to tentative plans, the first day's program will be devoted to a discussion of "Cost Reduction in Product Design." The second day's session will be a panel consideration of means of finding suitable men for the design-engineering field and methods of training them.

On the third day, two papers will be presented. The first will deal with problems relating to the selection of engineering materials and will consider how factors such as mechanical efficiency and economy influence the choice of the materials. The other paper will describe methods for effecting miniaturization and the new problems, in both design and manufacturing, which are created by miniaturization.

The subject of inventions and patents will be the topic for the closing day. One paper will discuss methods of awarding recognition and compensation to company employees for inventions developed by such employees. The other will be a legal explanation by an outstanding patent attorney of the rights of an employee in his inventions.

On the floor of the show, about 150 companies will exhibit components and materials which go into the making of end products. The top engineers of these suppliers of original equipment and materials will be in attendance at the booths to answer questions of visitors.

Advance registration cards for the show may be obtained from Clapp & Poliak, Inc., 341 Madison Ave., New York 17, N. Y. Information concerning the conference may be obtained either from the ASME or Clapp & Poliak.

## Meetings of Other Societies

**Feb. 16–17**
IRE, AIEE, and University of Pennsylvania, Transistor Circuits Conference, University of Pennsylvania, Philadelphia, Pa.

**Feb. 17–18**
National Society of Professional Engineers, annual spring meeting, Mayflower Hotel, Washington, D. C.

**Feb. 19–23**
AIME, annual meeting, Hotel Statler, New York, N. Y.

**Feb. 27–March 2**
American Society for Testing Materials, committee week, Hotel Statler, Buffalo, N. Y.

**March 12–16**
National Association of Corrosion Engineers, 12th annual conference, Hotel Statler, New York, N. Y.
(*ASME Coming Events, see page 195*)

## U of P Prepared to Train More Engineers

THROUGH a modernization of curriculums and facilities, the University of Pennsylvania finds itself able to accommodate 50 per cent more well-qualified engineering students than are now enrolled, according to an announcement made by Gaylord P. Harnwell, president, on November 15.

Concurring in the announcement was Henry B. Bryans, chairman of the University Trustees' Advisory Board of Engineering Education, a consultative body of outstanding men from the technical professions, which met during the afternoon of November 15 on the campus.

The decision to increase enrollments comes during the centennial of the University's engineering curriculums.

Carl C. Chambers, vice-president for engineering affairs, said a combination of circumstances had given the University's five engineering schools the capacity to educate more students without impairing academic standards.

He cited these factors:

In the modernization of curriculums, more emphasis has been placed on analytical studies and the humanities and less on shop-work and drafting, making certain facilities of the University available to more users.

Completion last year of the University's new physical sciences building has enabled the physics and mathematics departments to teach those required subjects to more engineering students.

Fuller use is being made of other buildings and facilities beyond the normal "classroom day," especially through an expanded evening program for graduate students.

As to faculty personnel, growth of the University's engineering research has drawn to the campus many highly qualified scientists who are available for teaching as well as for research.

In a joint statement, Drs. Harnwell and Chambers declared:

"Never during Pennsylvania's century of engineering education has technology been so basic to the national economy, defense, health, and social progress. Whether the United States is to lead or lag in realizing the potential benefits of atomic energy, automation, and scientific defense techniques depends on whether it educates enough competent engineers.

"That we have not enough engineers in 1955 has been well documented. Even the Delaware Valley area, long an educational mecca, is not educating as many new engineers as are needed in its own industrial and defense establishments.

"Accordingly, without relaxing our academic standards, we are undertaking to cultivate, admit, and educate a much greater number of the qualified young men and women essential to national progress."

About 1200 students presently are enrolled in the University's Schools of Chemical, Civil, Mechanical, and Metallurgical Engineering and its Moore School of Electrical Engineering.

## ESPS Celebrates 30 Years in San Francisco

THE American Society of Mechanical Engineers joins with other co-operating engineering organizations which sponsor Engineering Societies Personnel Service, Inc., in extending to the San Francisco, Calif., Office-ESPS congratulations and best wishes for continued success on the completion of the first 30 years of service to engineers of the western states. Of the 8000 western engineering positions filled with the assistance of San Francisco, 2000 have been for mechanical engineers in manufacturing, consulting, management, design, and other fields. ASME members of the San Francisco Section who have served on the local Advisory Committee include W. H. McBryde, F. Weymouth, G. W. Crozier, S. R. Dows, H. Berg, E. D. Howe, and presently Bertram S. Truett, district manager, American Meter Company. Ernest Hartford and O. B. Schier, 2nd, of ASME, serve on the National Board of Directors for ESPS.

# PIB Aeronautical Scientists Study Flight at 10,000 MPH—Plan to Blow World's Fastest Wind Using Air

WIND tunnels in the heart of Brooklyn, N. Y., may seem incongruous, but until recently some of the very important aeronautical research in the United States was being done there by the aeronautical engineering department of the Polytechnic Institute of Brooklyn. Now a modern $1 million aerodynamics laboratory, housing much of this research, has been built as a joint Brooklyn Poly-Air Force-Navy project at Freeport, L. I.

There Polytechnic scientists under the leadership of Dr. Antonio Ferri, internationally recognized aerodynamicist, hope to produce for the first time 5000 miles-per-hour winds for periods of about one-half minute, thereby obtaining information for flight at 10,000 mph.

When this is done many of the problems of supersonic (over 700 miles per hour) and hypersonic flight (speeds over 3500 miles per hour) can be studied under closely simulated flight conditions. The importance of these data for the design and construction of rockets, missiles, and supersonic airplanes cannot be overemphasized.

### Pioneer Project

Presently there is no other known place in the world where scientists are able to study the effects of hypersonic speeds upon structures under such accurately reproduced flight conditions.

While the natural reticence of the scientist rules out any flat predictions concerning the anticipated achievements of the hypersonic wind tunnel at Freeport, considerable faith in its eventual success has been expressed at the highest levels. Already air has been brought into the hypersonic tunnel at 2500 F temperature, the highest ever in any air tunnel. This achievement is a key step in the procedure developed by Dr. Ferri and his associates and has generated a "cautious optimism," as the winds blow now at about Mach 6 (4000 mph).

The Polytechnic aero staff—now in its second decade of service to the aircraft industry and the nation—hopes that the hypersonic group will produce many more "firsts," outranking even Poly's pioneering courses in helicopters and jet propulsion, and its many contributions to the basic science of aeronautics.

Since World War II, 84 sponsored research contracts have been placed in the Poly aero laboratories by government and industry. Today there are 20 such projects being conducted for aircraft companies as well as various government agencies—the Air Force, the Office of Naval Research, the National Advisory Committee for Aeronautics, and the Army.

### Top Scientific Team

This research was brought to Polytechnic because of the personnel staffing the aeronautical department, led by Nicholas J. Hoff, Mem. ASME, one of the world's first masters of aeronautical structural analysis, whose formulas have served as a guide in aircraft development since 1938. Another distinguished scientist whose reputation attracted research was Hans Reissner, Mem. ASME, now retired, but whose achievements date back to 1913 when he designed and built the first all-metal plane to fly, and whose work in propeller theory and flight stability has been of primary importance. The afore-mentioned Dr. Ferri, runs the aerodynamics laboratory to which an ever-increasing volume of research is being referred.

A "comer" on the Poly staff who for all practical purposes has "arrived" in the select circle of internationally known scientists is the 33-year-old Philip G. Hodge, Mem. ASME, already acknowledged as one of the best men in the field on plasticity, the branch of study which tells accurately when a structure is going to fail.

Dr. Hoff and the Polytechnic president, Harry S. Rogers, Mem. ASME, are also proud of three Poly-trained younger scientists who already have national reputations and who give promise of moving into the rarefied atmosphere of international recognition. They are Paul A. Libby and Martin Bloom, high-speed aerodynamics specialists, and Joseph Kempner, expert in stress analysis and elasticity.

This group of scientists, along with the well-known and respected men like Shao-wen Yuan, Leonard Meyerhoff, and others, have published over three-hundred technical papers in the past few years. This productivity is a measure of the solid volume of creative work being turned out in the department.

### Current Research

The 20 research projects now in process include several on "creep," the insidious buckling which destroys airborne structures; the plastic analysis of structures; an experimental and theoretical study of temperature distribution, and the stresses set up by friction-generated heat on the surfaces of supersonic craft.

In the aerodynamics field several investigations are concerned with supersonic compressors, the effects of mixing supersonic and subsonic flows of air, the designing of cowl configurations in supersonic flow. Important studies in wind-tunnel testing are also in progress.

In an interesting counterpoint, the aero group also is investigating two structural projects involving submarine design, i.e., the blast effects on submarine structures and the transverse strength of submarines, as well as a study on underwater ducted blade systems.

### Services to Aviation Industry

As an example of its dynamic relationship with industry in its aims and in meeting needs, Polytechnic conducts several high-level graduate courses in aeronautical engineering in Mineola, Long Island, N. Y., readily accessible to the technical personnel of Long Island's large aircraft industry. These courses, offered by Poly's top scientists, bring the latest developments in the field to the immediate use of the aircraft designers and builders. About 250 registrants from the aviation industry each year take evening courses at Mineola and in Brooklyn.

The accessibility of the Aerodynamics Laboratory at Freeport, L. I., has also proved a boon to many of the aviation companies. Test and design problems can quickly and easily be referred to the Laboratory, with personal consultation and interchange of ideas convenient and frequent.

The services rendered by educational institutions in providing the qualified personnel to keep these industries vital and productive should be, and are, measured in terms far beyond the obvious immediate implications.

# AWS to Stage Welding Show in Buffalo, May 9; ASME Division, AEC Committee to Cosponsor Some of the 21 Technical Sessions

THE fourth Welding Show, sponsored by the American Welding Society, will be staged in the Memorial Auditorium, Buffalo, N. Y., May 9 to 11.

The exposition will be one of the largest ever held in the industry. It will exceed by one third the size of exhibits at the Kansas City, Mo., show in 1955, and by 28 per cent, the record set when the show was last held in Buffalo in 1954.

Coincident with the show, the society will conduct its annual business meeting and a series of technical conferences. The Metals Engineering Division of The American Society of Mechanical Engineers will, for the first time, join the American Welding Society in sponsorship of four sessions in which both groups have a mutual interest.

The Welding Committee of the U. S. Atomic Energy Commission also will cosponsor a session.

Twenty-one technical sessions, with approximately 50 speakers, are planned. An innovation this year will be a discussion of safety, health, and fire prevention by the society's technical-activities committee.

Other features planned include a Welding Conference, which will consider practical aspects of welding for industrial executives and a series of educational lectures for engineering students.

The show will feature more live demonstrations of welding processes and equipment than ever before attempted.

Technical papers will be read and business sessions of the society will be conducted at the Hotel Statler. The Auditorium will be used for the exhibits, lectures, and Conference.

# American Concept of Freedom Sparked Technological Explosion

## G. M. Read Addresses U of P Centennial Symposium

THE spark which touched off our technological explosion was the American concept of freedom, said Granville M. Read, Mem. ASME, chief engineer of the du Pont Company, at the University of Pennsylvania's Centennial Symposium of Modern Engineering, Nov. 11, 1955.

In an address entitled, "Profile of Human Materials," Mr. Read said, "The effect of freedom and its incentives was to create a huge suggestion box. Throughout America men and women gave rein to their curiosity and their ingenuity with a better life as a goal. As productivity increased, they had something to share with others, and they gave thought to human relations.

"History records in bold relief the rise and fall of nations, dynasties, organizations, and individuals. Why have they fallen? I believe the primary reason has been the failure of those who ruled to recognize the potential energy and ability of the masses of the people. The leaders thought only of themselves, and failed to take those steps in human relations which would bring out the best efforts of the many."

Mr. Read pointed out that recent discoveries and development of new physical properties in engineering materials have accelerated technological progress. These materials, not even dreamed of a hundred years ago, are now the seven-league boots in which technology is making giant strides.

### American Technology Powerful Influence

But in the last analysis, Mr. Read said, "It is upon our human materials that we must depend in civilization's climb toward the summit. The ancient Greeks improved our communication through language, and the Romans gave us law, but in more recent times, the driving force of American technology has become the most powerful influence in the world.

"There has been little change," he said, "in either the anatomy or physiology of man since the New World was founded. We eat and drink about the same things as our ancestors did a hundred or even three hundred years ago. What, then, was responsible for this vast surge of technological accomplishment which is banishing the spectre of famine, and has increased our life span fifty per cent, cut our working hours in half, and given us comforts and a splendor of living the richest king would have envied?"

### American Concept of Freedom

The answer, Mr. Read believes, lies in the American concept of freedom coupled with the recognition of the humanities of life by a free society.

"Today," he said, "we find our human materials, as well as our physical materials, vastly improved over those of 1855. The problem presented in our profile is how we can be sure that the contours continue to curve upward for the benefit of all mankind."

### Specifications for an Engineer

One way to be sure, Mr. Read said, is to set up rigid specifications for the engineer of tomorrow. Among these specifications he cites such things as health and spiritual character, leadership, courage, dependability, formal education, creative power, economic prudence, and human relations. On this latter point, he said, "A potential leader must be keenly aware of the feelings and problems of those with whom he works and associates. He must think and act in terms of each individual. The real secret of successful industrial relations is respect for individual dignity."

Mr. Read pointed out that human materials, like construction materials, must be examined continuously and at various load levels to determine their carrying capacity. In addition, he said, "we must also think of the maintenance of our human materials. Stress and strain can be just as damaging to individuals as to wood and steel. We should never try to make work horses out of race horses, or vice versa."

He believes that management today is tardy in giving younger men greater responsibility. "Our future progress," he said, "may depend upon whether we give younger men the responsibility they and they alone are capable of exercising."

As one suggestion to the universities and colleges, Mr. Read asked for greater stress on the humanities of life. "Beyond question, the college graduate is the most valuable raw material received by industry. College is the place where the attitude of our youth is set and molded. I know that the home, the community, and the church have an important influence, but the formative years are spent on the campus. It would be helpful, in my opinion, if the college instructor would stress the importance of the humanities of life, for these may prove more valuable in later years than the ability to conjugate the verb 'to be,' or solve the most intricate mathematical problem."

# Pegram Laboratory Including a 6,000,000 Electron-Volt Generator, Is Dedicated

THE George B. Pegram Laboratory, containing a 6,000,000 electron-volt generator for nuclear research, was dedicated Nov. 18, 1955, at Columbia University.

Construction of the laboratory began the first of this year. It has been completed at a cost of about $400,000. The Van de Graaff generator, which cost $450,000 installed, was lent by the Atomic Energy Commission. The commission also contributed $295,000 to the construction cost of the building.

### Laboratory Honors Dr. Pegram

The laboratory is named for Dr. Pegram, Fellow ASME, an atomic physicist who served as chairman of the Columbia University Committee on War Research from 1941 to 1945. He was a key figure in the establishment of the Manhattan District project, which produced the first atomic bomb. Dr. Pegram is now vice-president emeritus of Columbia and a special adviser to the president of the university.

"Of course I feel deeply honored," Dr. Pegram said at the informal ceremonies in the laboratory. "But I think the real hero should be Professor Havens. He will continue the fine work."

### The Generator's Function

The 40-ton generator is $22\frac{1}{2}$ ft tall. An electronic charge sprayed on a conveyer belt at the bottom of the columnar generator is carried to an electrode at the top, Professor Havens explained.

Charged hydrogen nuclei, called protons, are then sent down through the generator, accelerated to a high energy. At the bottom a selector magnet turns the descending protons at right angles and projects them into the laboratory.

This beam of protons bombards a target. The reaction in the target material will aid Professor Havens in determining the properties of the nuclei of the material's atoms.

"I hope to have some results by spring," he said.

Those who spoke at the dedication ceremonies in honor of Dr. Pegram were John R. Dunning, Mem. ASME, dean of the School of Engineering and an atomic physicist; Jacques Barzun, dean of the Graduate Faculties; and Prof. W. W. Havens, Jr., who will be in charge of the generator.

# Speed Scientific School Receives Gift

R. C. ERNST, dean, Speed Scientific School, University of Louisville, announced a gift on November 8 from the late William S. Speed, Mem. ASME, and Mrs. Speed, of $450,000 to the Speed Scientific School toward the construction of a building for civil and electrical engineering. This is a continuation of the fine gifts of the Speed family which now total in excess of a million dollars.

# Israeli Specialist Warns Against Putting "All Power Eggs in One Atomic Basket"

Sharp criticism of present world preoccupation with atomic energy was voiced Sunday, November 20, by Nathan Robinson, Israel solar radiation specialist, at the final session of the two-day "Conference on Technology for Israel and the Middle East," held at the Hotel Statler, New York, N. Y., under sponsorship of the American Technion Society.

Conceding that atomic power probably was the solution to power problems in large industrial concentrations, such as major cities, Dr. Robinson pointed out that for greater portions of the globe, the underdeveloped continents, as well as the rural and semiurban sections of the United States, atomic plants would be unfeasible for economic reasons.

Dr. Robinson, who is head of the Solar Radiation Laboratory of Technion, Israel Institute of Technology, represented Israel at the recent World Conference on Solar Radiation in Phoenix, Ariz.

"The expensive units required, the highly technical skill and training required in setting up atomic plants, and the cost of raw material must effectively keep atomic power in the luxury class for many years to come," Dr. Robinson said.

"In contrast to this," he stressed, "solar radiation is available everywhere, irrespective of transport problems and skilled manpower. The basic principles of utilization of the rays of the sun already are well known, and tremendous advances are now being made in construction of cheap conversion and storage units. Solar hot-water heaters already are on public sale in Israel.

"Problems of national security also should dictate caution in this field. No one yet knows how extensive are the world's deposits of uranium, and it would be suicidal for any nation to build its industrial structure on a power system dependent on a raw material which might one day have to be obtained by import.

"Don't put all your power eggs in one atomic basket," Dr. Robinson concluded, reminding his audience that the sun is freely available everywhere.

Prof. Joseph Weil, dean of the College of Engineering of the University of Florida, spoke on "Industrial Problems of Florida Compared to Those of Israel" and pointed to several interesting similarities.

Climate that produces citrus and other semitropical fruits, problems of water control and irrigation, problems in attempting to prevent water pollution at low cost, new oil-digging operations, and handicraft industries were among the parallels drawn between Florida and Israel.

Professor Weil also indicated that Israel may find it possible in time to compete "on an equal basis with other nations" in the field of nuclear energy. He pointed to the fact that Israel has large phosphate deposits, and that the phosphate ores may be able to yield sufficient uranium for commercial-power uses.

Victor Salkind, scientific counselor of the Embassy of Israel, and Orhan Barim of Turkey, project officer of the Technical Assistance Program of the United Nations, were principal speakers at a luncheon given for some 300 technical leaders who attended the conference.

Mr. Salkind said that the most modern and scientific methods of research, development, and production must be utilized by Israel "to exploit our hitherto limited natural resources."

"Only in this way," Mr. Salkind said, "can we compete in the world markets—or survive." He stressed that technical training in the fields of engineering and applied science is the greatest need in Israel's drive for economic security.

Mr. Barim talked of highway-development problems in the Middle East and said that "initial expert missions into the countries of the Middle East have indicated that training of local engineers and technicians should be considered an important requisite to sending experts." He added that the United Nations Technical Assistance Administration has organized a training center in the field of highway development with headquarters in Ankara. So far, he said, in co-operation with the Turkish highway department, close to 40 engineers from the area have been trained in modern highway techniques.

## Society of Rheology Meeting Report

The annual meeting of The Society of Rheology was held in New York, N. Y., Nov. 2–4, 1955. Over 120 members and guests attended the technical sessions which were held at the Henry Hudson Hotel.

At the dinner on November 3, Herbert Leaderman of the National Bureau of Standards was presented the Bingham Medal of the society. John D. Ferry, of the University of Wisconsin and recipient of the 1953 Bingham Award, made the presentation. Dr. Ferry reviewed Dr. Leaderman's research and writings in the field of rheology and his work in preparing and promoting an international standard of nomenclature for the science of flow and deformation of materials.

The well-rounded technical program of the meeting was divided into five half-day sessions. Four papers on various aspects of the rheology of metals were presented at the first session, Wednesday afternoon. The mechanism by which a metal stores the energy of cold work was discussed. Data on the dynamic elastic modulus and plastic deformation of copper were presented in terms of theoretically predicted effects of interstitials and vacancies. The resistivity effects of short-range order in oc Brass were presented in terms of relaxation times obtained from resistance increases induced by quenching and resistance decreases induced by neutron irradiation. A paper on the effects of combined stress on aluminum concluded the first session.

The growing interest in rheology in earth sciences was brought out by papers dealing with the deformation of the earth and flow patterns in glacier ice. Papers dealing with the magnet of fluid dynamics of both compressible and incompressible liquids and th deformation of porous viscoelastic anisotropic solids completed the second session.

The mathematical approach to rheological problems was presented in three papers dealing with hypoelasticity, the stability of flow of incompressible viscoelastic fluids, and the mechanical behavior of fibers.

Developments in the study of the viscoelastic properties of high polymers was the subject of the fourth session. The use of stress-strain curves to characterize the properties of polyisobutylene was discussed and a testing method for determining the dynamic mechanical properties of plastics was presented with data on the behavior of polymethyl methacrylate. A method of determining the dynamic bulk modulus was described together with data taken over a wide frequency range on several rubber-sulphur mixtures. The similarity between the behavior of melts and polymer solutions was demonstrated with data on molten polyethylene. The final session included a description of a vibratory gyro mass flowmeter and a method for the determination of structure in dispersions by viscometry. The gradient dependence of intrinsic viscosity was discussed in reference to the determination of the flow inside the space occupied by the macromolecule. Fracture in viscoelastic liquids under shear stress was demonstrated with data taken on the extrusion of melted plastics through capillaries and slits.

At the business meeting F. D. Dexter (Bakelite) was elected president; J. H. Dillon (Textile Research Institute), first vice-president; J. H. Elliot (Hercules), second vice-president; Bryce Maxwell (Princeton University), editor, and W. R. Willets (Titanium Pigments), secretary-treasurer.

## Russians Claim a "First" in Safe Limits for Smog

The Russians, in another move to be "the first," have claimed that they have established safe limits for smog in the atmosphere of cities.

Frederick S. Mallette, executive secretary of The American Society of Mechanical Engineers Committee on Air Pollution Controls, said in a recent interview, "This Russian claim to originality appears to have some basis, for the United States has not yet reached such an advanced state of knowledge.

"According to the recently published Russian book, 'Sanitary Safeguarding of Atmospheric Air,' by V. A. Riazonov," Mr. Mallette emphasized that "the Russian values appear to have been based on permissible limits for factory atmospheres—a field in which U. S. industry has been making great strides.

"The Russian figures, however, are far below what the United States considers dangerous levels," continued Mr. Mallette. "Their limit for lead of 0.0007 milligram per cubic meter of air is many times lower than the 0.0009 milligram per cubic meter found at congested street intersections."

# Junior Forum

Conducted for the National Junior Committee

by R. A. Cederberg,[1] Assoc. Mem. ASME

## The Young Mechanical Engineer in Sales

By William F. Beckman[2]

ENGINEERING sales is, to many, the most interesting and challenging of the many fields toward which the young mechanical engineer may direct his efforts. Today it is one in which almost unlimited opportunity exists throughout industry.

Experience in technical selling imbues an engineer with the importance of cost as a function of design and develops a keen sense of purpose and utility of design. It will keep him abreast of developments in his field and he will acquire fundamental knowledge, at least, of the many industries where his products are used. All of these day-to-day experiences provide ample opportunities for observation, growth, and for the expression of creative thinking and ingenuity.

Beyond the technical field, a sales engineer will of necessity develop an understanding of business and contract methods and procedures which, along with his experience in dealing with people, will prove to be valuable assets in achieving any individual goal he may set.

A broad hypothesis indeed. However, it is one that can quite clearly and logically be established from a consideration of the day-to-day activity of the multitude of engineers engaged in this type of selling throughout the industrial world.

### What Does a Sales Engineer Do?

An engineering salesman is usually concerned with applications of his products, or systems of equipment, that are special and unique and which will require computation, special handling, and, perhaps, design consideration. The item being considered may be a single unit, such as a special tool, gage, pump, clutch, coupling, or gear reducer; or, it may be a complete engineered system to perform many functions such as a multioperation machine tool, a steam generator or prime mover, a materials-processing or conveying system.

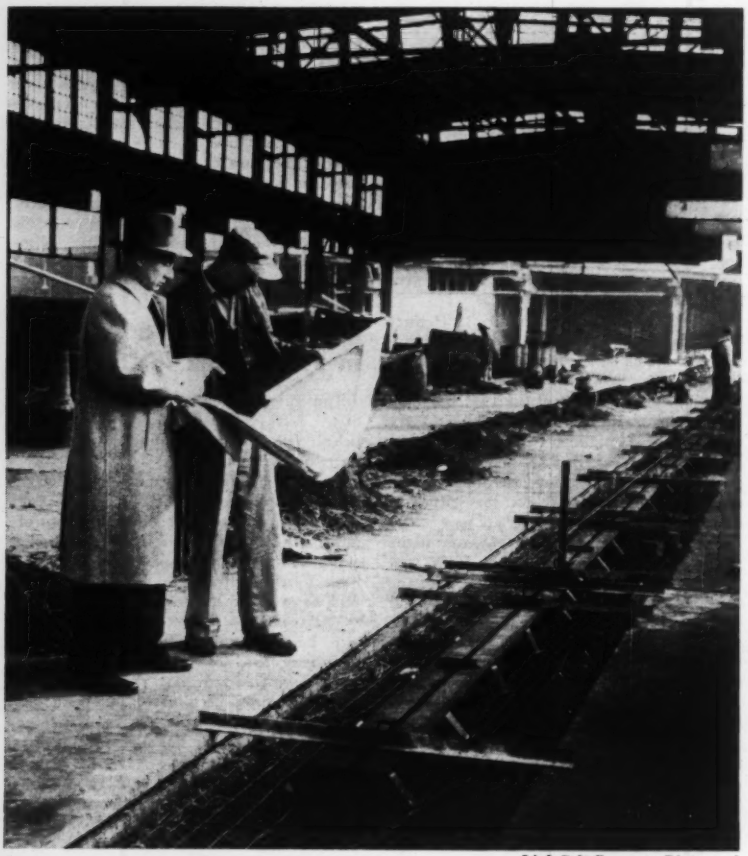
Sales engineers in most organizations are usually assigned several collateral duties in addition to their primary work. They may be called upon to co-operate in writing sales manuals, reviewing advertising copy, recommending new designs of the machinery with which they are concerned, and analyzing market conditions to establish sales quotas and inventories of material.

### Opportunity Unlimited

An engineering sales position offers the engineer the opportunity to gain both experience and knowledge in the art of self-expression and in business methods and procedures. A salesman must deal with people and his success in his job will, to a considerable extent, be measured by his ability to clearly speak his mind to convince his customers of the workability and desirability of his products, designs, and ideas.

Most engineered projects involving mechanical equipment are bid and purchased on a lump-sum contract basis. This requires careful consideration of contractual obligations involved in the performance of the entire system as well as of the individual components. As a result, the sales engineer will become familiar with contract terms and procedures and will gain much valuable business experience in the course of his work.

Many times, in an engineered project, a small unique design feature or advantage will contribute much to successfully closing the sale. In these situations the engineering skill and creative imagination of the engineering salesman will be utilized to their fullest extent and may be the difference between a sale and a lost order. These same characteristics are important in exploiting all the possible solutions for any given inquiry. Further along this line, any progressive organization is constantly improving the design of its products and the recommendations of the sales engineer can be of the utmost importance in the success of this program.



*Link-Belt Company Photograph*

**W. F. Beckman, *left,* discussing the details of an in-the-floor type Trukveyor with an erection superintendent on job site**

[1] Westinghouse Electric Corp., Radio-Television Division, Metuchen, N. J.

[2] Sales Engineer Link-Belt Company, Chicago, Ill. Assoc. Mem. ASME.

Quite naturally, one of the primary individual considerations of any job will be the remuneration involved. It is quite difficult, however, to be specific in this regard or to gather statistical data. In general, the pay will be commensurate with the ability and experience of the individual and with the responsibilities assigned. Most organizations will state that an individual's worth will depend on his performance; this, however, will be largely dependent on the foregoing items.

The responsibilities assigned to engineering sales personnel will vary from company to company because of the wide scope of the work involved. Usually, the responsibilities assigned will be greater than those involved in corresponding jobs in other departments. As a result, the range of pay for sales engineers is often greater than for other jobs involving less responsibility. Most major companies pay their engineering sales personnel on a straight salary basis. However, some organizations have arrangements that tie remuneration to performance by way of a bonus or profit-participation plan. A few companies compensate their engineering salesmen on a commission basis. Under any of the foregoing conditions, an alert engineer in a fertile field can do well for himself while acquiring experience that can provide the foundation for achieving other goals.

### The Thorns on the Rose

There are, of course, certain discouraging aspects to the job of selling, too, just as there are to any occupation.

The nature of any selling position requires that the product or service be brought before the user. This necessitates travel which even today is time-consuming. It creates irregular hours and requires time away from home.

The salesman's work schedule is governed, to a large extent, by the schedules of the people on whom he calls, which contributes further toward irregular and ofttimes long work periods. Surges in the flow of inquiries will, on occasion, necessitate rather protracted periods of extreme activity to meet customers' schedules.

The sales engineer must learn to take the bitter disappointment of losing an order on which he may have worked for weeks or months. He must be able to go after the next one with even more vigor and enthusiasm.

### Conclusion

The hypothesis that engineering sales is a vitally interesting vocation that offers great opportunity to a mechanical engineer, not only as an engineering job but to increase and broaden his experience in business activity and in dealing with people, has been expanded by definition and description. Sales experience is of paramount importance in acquiring qualifications for administrative or managerial positions.

Whatever goal the individual tyro engineer may set for himself, the outlook and background he will acquire in selling will be contributing factors in his future success.

## ASME Membership

**as of Dec. 31, 1955**

| | |
|---|---|
| Honorary Members | 72 |
| Fellows | 408 |
| Members | 14,669 |
| Affiliates | 301 |
| Associate Members (33 and over) | 3,806 |
| Associate Members (30–32) | 4,453 |
| Associate Members (to age of 29) | 17,215 |
| Total | 40,924 |

## NSF Releases Report on U. S. Industrial Research and Development

INDUSTRIAL research and development effort in the United States cost $3.7 billion in 1953 and required the employment of nearly 30 per cent of all scientists and engineers in industry, as shown in a definitive study conducted by the Bureau of Labor Statistics for the National Science Foundation released by Alan T. Waterman, Foundation Director.

The report, "Science and Engineering in American Industry—Preliminary Report of a Survey of Research and Development Costs and Personnel in 1953–1954," is based on a questionnaire survey of a sample of approximately 11,600 companies carefully chosen as representative of American industry.

"The gratifying response from nearly 90 per cent of the companies surveyed shows clearly the increasing emphasis industry is placing on research and development," Dr. Waterman said. "On the basis of this survey, and other studies now under way, we must revise upward to more than $5 billion the total cost of research and development performed by private industry, educational institutions, Government agencies, and all other types of organizations. Private industry performs roughly two thirds of all research and development in the natural sciences and engineering. Over one third of this amount is done for the Federal Government chiefly on contracts with the Department of Defense and the Atomic Energy Commission. However, the survey indicates that only 4 per cent—nearly $150 million—of the total cost of research and development conducted by private industry in 1953 went into basic research."

# ASME Standards Workshop

## Interpretations of 1955 Code for Pressure Piping

FROM time to time certain actions of the Sectional Committee B31 will be published for the information of interested parties. While these do not constitute formal revision of the Code, they may be utilized in specifications, or otherwise, as representing the considered opinion of the Committee.

Pending revision of the code for Pressure Piping, ASA B31.1-1955, the Sectional Committee has recommended that ASME, as sponsor, publish selected interpretations so that industry may take immediate advantage of corresponding proposed revisions.

The following cases are published herewith as interim actions of Sectional Committee B31 on the Code for Pressure Piping that will not constitute a part of the Code until formal action has been taken by the ASME and by the American Standards Association on a revision of the Code.

### Case No. 22

*Inquiry:* In the ASA B31.1-1955 Code for Pressure Piping, Section 3, Par. 325 (Table 11) the Type-H solder-joint fittings for Instrument and Control piping and their ratings are limited to those conforming to ASA Standard B16.18. Are wrought solder-joint fittings conforming to ASA Standard B16.22 acceptable? Is it permissible to apply the fittings to service other than those indicated in Table 11? May the rating vary with the types of solders used?

*Reply:* It is the opinion of the Committee that wrought solder-joint fittings conforming to ASA Standard B16.22 may be included as Type-H fitting in Par. 325 (Table 11) in the subject Code. The services of Type-H solder-joint fittings shall be limited to those specified in Par. 325 (Table 11), and the ratings shall be limited to those published in the ASA Standard B16.18 for cast fittings and ASA Standard B16.22 for wrought fittings, for the solders specifically named in each standard.

### Case 23

*Inquiry:* Do the provisions of Par. 831.41(*b*), Section 8 of American Standard Code for Pressure Piping (ASA B31.1.8-1955) apply to reinforcement sleeves, placed over welds or dresser-type couplings?

*Reply:* Par. 831.41(*b*) applies to local reinforcement of welded branch connections, but not to reinforcement sleeves of circumferential pipe-line joints. It should be the responsibility of the installer to determine that failure of neither the reinforcing sleeve, nor the carrier pipe will occur, should fluid become trapped in the annular space between their surfaces.

## Help Break the Patents Backlog

AMERICAN industry is facing long delays in obtaining patent coverage for products and processes otherwise ready for the market, according to reports made at the fall meeting of The New York Patent Law Association, which was addressed by the Commissioner of Patents.

These delays stem from the great increase in the number of patent applications filed during the past few years. This flood of inventions has stretched the average prosecution time per patent to three and a half years.

The Association points out that the Patent Examiner holds a key position in the advancement of American technology and that the only way to reduce these delays and clear the way for marketing the new products and processes is to employ new Patent Examiners to pass upon the backlog of applications which is piling up in almost every technical field.

Steps have already been taken in this direction and over 100 new Patent Examiners have been added to the examining staff since June, 1955, and it is understood that the Patent Office plans to build this number up to a total of 350 new Examiners by the end of 1956.

There are immediate openings for engineers and scientists who can accept appointments as Patent Examiners this fall, and the Association points out that technical graduates who apply will find the job interesting and challenging and one in which they are kept in close touch with the latest technical developments. The job also offers opportunities for advancement within the Patent Office.

The salaries for Examiners start at $4345 a year, and it is possible to reach a salary of $7570 in five and one half years. The Patent Office also offers liberal vacations and sick leave and pension benefits.

Engineers and scientists holding a college degree in engineering or applied science, or a degree with a major in chemistry or physics, or with certain combined credits in these fields, are eligible for appointment as Patent Examiners, without examination, upon application to the Commissioner of Patents in Washington, D. C.

# Actions of the ASME Executive Committee

## At a Meeting at Headquarters, Jan. 6, 1956

A MEETING of the Executive Committee of the Council was held in the rooms of the Society on Jan. 6, 1956. J. W. Barker, chairman, presided. In addition to Mr. Barker, there were present: F. L. Bradley, F. W. Miller, A. C. Pasini, Louis Polk of the Committee; H. J. Bauer (Finance), G. M. Muschamp (Organization), J. L. Kopf, treasurer, E. J. Kates, assistant treasurer, W. H. Byrne, vice-president, Joseph Pope, director; C. E. Davies, secretary, D. C. A. Bosworth, T. A. Marshall, Jr., O. B. Schier, 2nd, assistant secretaries; and Ernest Hartford, consultant.

### Society Privileges to Newly Elected Members

At the present time the newly elected member does not receive MECHANICAL ENGINEERING nor is his name put on the Section mailing list until he pays his initiation fee and the pro-rata share of his annual dues to the end of the fiscal year.

To reduce the clerical load, and with the expectation that the procedure should reduce the number of Student transfers that are voided, the Executive Committee of the Council voted to authorize the Secretary to extend the privileges of the Society to members immediately upon election, before payment of dues, for a trial period of six months and to request the Constitution and By-Laws Committee to consider a change in the By-Laws to become effective in November, 1956.

### Agreement With Battelle Memorial Institute

The Secretary reported the extension to December 31, 1956, with an additional appropriation of $1000, of a contract between Joint ASTM-ASME Committee on Effect of Temperature on the Properties of Metals and Battelle Memorial Institute on research investigations in connection with compilation of high-temperature data for carbon steel, bolting steels, and chromium steels for the Data and Publications Panel Project DP-8. The necessary funds are available in the custodian account of the Joint Committee.

In order to simplify procedure in contract matters, the Board of Directors of ASTM and the Executive Committee of ASME on May 20, 1952, authorized the ASME to serve as the Contracting Agent for contracts authorizing research for the Joint ASTM-ASME Committee.

### Lubrication Division Custodian Account

The Lubrication Division held two Divisional conferences, the first in Baltimore, Md., in 1954 and the second in Indianapolis, Ind., in 1955, both of which resulted in a small net profit. Upon recommendation of the Lubrication Division, the Executive Committee of the Council voted to authorize a custodian account for the Lubrication Division, for expenditures and accounting, under the procedure of the Society.

### Public Relations

On Sept. 28, 1955, the President appointed an Ad Hoc Committee on Public Relations, consisting of J. W. Barker, chairman, F. L. Bradley, and A. C. Pasini, "to appraise the results of our public-relations activities and recommend a future program." The Committee has had several meetings, and as a result of its work Chairman Barker made an extended oral report. The Committee considered the relative merits of (1) having the entire public-relations efforts carried on in the office of the Society; (2) having them carried on entirely in the office of the public relations counsel; and (3) having routine work carried on in the office of the Society and additional services provided by public-relations counsel.

The Committee recommended a public-relations budget part of which would be spent in the office of the Secretary and a part to be available under the direction of the Secretary.

The Committee also recommended the retention of Ketchum, MacLeod & Grove, Inc., as public-relations consultants to ASME.

The Committee further recommended that it be continued as a standing committee to give policy guidance to the administration of the public-relations program. The Executive Committee of the Council, after discussion, voted to recommend that the Society embark on a public-relations program as outlined by the Ad Hoc Public Relations Committee; to retain Ketchum, MacLeod & Grove, Inc., as public-relations counsel to the Society; to refer to the Finance Committee the question of providing the funds; and to continue the present Ad Hoc Public Relations Committee as a standing committee of the Council.

### 1955 Power Show

The Executive Committee of the Council authorized crediting to the Research Reserve $5372.50 received from the International Exposition Company, complete payment to the Society in connection with the 1955 Power Show held in Chicago, Ill., November, 1955.

### President's Travel

In 1952 a committee of the then five Junior Past-Presidents adopted a statement of policy to guide travel of the President. In reviewing this policy for insertion in the Manuals of the Society, the Secretary and staff felt that some changes were desirable and, accordingly, presented a suggested modification, which was approved by the Executive Committee of the Council.

The requirements for presidential travel at the present time are too large for any President to encompass them in a single year. President Barker urged, and was supported by the Executive Committee, that a scheme of travel be laid out for a five-year period which will give opportunity for contacts to be made at regular intervals, except at those places where special difficulties require more frequent attention. The staff is engaged in the preparation of such policy.

### Student Members

The Secretary reported a communication from G. A. Hawkins, director, ASME, dated Dec. 7, 1955, suggesting that students at the University of California (L. A.) who have indicated their interest in ASME by subscribing for MECHANICAL ENGINEERING and the privilege of participating in the activities of the Southern California Section should be eligible for transfer to Associate Member grade—the same as any other mechanical-engineering student who belongs to an ASME Student Branch. The Executive Committee

referred this proposal to the Constitution and By-Laws Committee for favorable consideration.

## Certificates of Award

The Executive Committee of the Council authorized a special certificate for sixty-five years of membership in the Society for the following: George M. Brill, Gordon Campbell, J. S. Foster, Walter E. Hopton, Joseph G. Prosser, and Charles H. Repath. A Certificate of Award was granted to L. N. Rowley, Jr., retiring chairman of the Finance Committee.

Certificates of Award were granted to the following chairmen of Sections:

Frank D. Cotterman, Chicago
M. G. Patrick, Columbia Basin
Charles O. Kishibay, Fairfield County
Louis E. Staak, Fort Wayne
Donald D. Dewar, Inland Empire
Edlow S. Bance, Long Island Subsection
Bill E. Forney, Mid-Continent
Allen R. Deschere, North Alabama Subsection
Herman Ritter, Plainfield
Hugh Knobeloch, Rock River Valley
L. F. Richardson, Southern California
A. Wiley Sherwood, Washington, D. C.
Kenneth E. Merz, Waterbury
William H. Weaver, Western Massachusetts
George B. Thom, Northern New Jersey Subsection

The Executive Committee of the Council authorized the granting of a Certificate of Award to S. Logan Kerr for his service on the Hydraulic Executive Committee, 1935–1939 and 1953–1955, serving as chairman 1936–1938.

## New Engineering Societies Building

The Executive Committee of the Council approved an extension of time to May 1, 1956, for the final report of the Task Committee on New Engineering Societies Building.

The chairman of the Task Committee, B. F. Dodge, under date of Dec. 22, 1955, wrote to each of the 21 signatories of what is commonly known as the "Kelly letter" of June 8, 1955 (see MECHANICAL ENGINEERING, August, 1955, p. 752.) advising them of the action which has been taken as a result of the letter. In the letter Mr. Dodge advised that "one of the first actions taken (by the Task Committee) was to pass a resolution stating that this task force would be guided in its deliberations by the principles which were laid down in the letter."

Mr. Dodge reported that the Task Committee has chosen the firm of McKinsey and Company, management consultants, to assist it in its task of selecting a site. McKinsey and Company have offices in five large cities in addition to its headquarters in New York, N. Y.

In the light of questions asked at this meeting as to the manner in which the various communities might wish to present their proposals to the Task Committee, the Executive Committee requested the Secretary to secure a short progress report from the three ASME representatives which could be disseminated to those requesting information regarding the selection of a new site.

## Membership of ASAE in EJC

The recommendation that the American Society of Agricultural Engineers become an Associate Member of Engineers Joint Council was approved.

## Visit of Russian Engineers to U. S.

The Secretary reported a letter dated Dec. 9, 1955, from L. T. Merchant, Assistant Secretary, Department of State, Washington, D. C., expressing appreciation "for the time, effort, and expense undertaken by the ASME in sponsoring the recent visit of Soviet Automation experts." He wrote, further, that "your personal efforts and those of the Society constitute, in my opinion, a significant public service." The Secretary was directed to arrange for the publication of this letter in MECHANICAL ENGINEERING. (See page 197.)

A detailed report of the tour of the Soviet Automation Team in the United States, Nov. 14–30, 1955, was prepared by Stewart E. Reimel, tour conductor, and reported to the Executive Committee. The Secretary was asked to extend to General Reimel the sincere thanks and appreciation of the Executive Committee.

## Deaths

The Executive Committee noted with regret the death on Dec. 8, 1955, of H. P. Liversidge who served as manager of the Society 1921–1924.

The Secretary reported the death on Jan. 4, 1956, of Ralph S. Damon, Member of the Society, who, in 1955, was awarded the Spirit of St. Louis Medal. The Executive Committee of the Council adopted the following memorial for record in its minutes and for transmission to the family of Ralph S. Damon:

The Council of The American Society of Mechanical Engineers records with deep sorrow the death on Jan. 4, 1956, of Ralph S. Damon, a member of the Society since 1941 and Spirit of St. Louis Medalist in 1955. They recall with appreciation and satisfaction the many services which Mr. Damon rendered in the fields of aviation and air transportation in which the Society has had an active interest for more than half a century and the address he delivered at the 1955 ASME Annual Meeting in which he said: "Could aviation speak as an individual, its philosophy would be: 'I can annihilate space and time; to do this I must be understood; I must be nurtured and not whipped. I can promote understanding among peoples; I can be the implement of peace, prosperity, and happiness for all'". Ralph Damon devoted his life to the application of this philosophy.

## Appointments

The Executive Committee noted the following appointments of presidential representatives: New Mexico College of Agriculture and Mechanical Arts, State College, N. Mex., Inauguration of President, Jan. 13, 1956, J. M. Hardgrave; and National Conference on Public Works, Washington, D. C., Jan. 16–17, 1956, R. L. Goetzenberger and M. X. Wilberding.

The appointment of Linn Helander as representative of Region VIII on the Regional Advisory Board of the Publications Committee was reported by C. H. Shumaker, vice-president, Region VIII.

# Engineering Societies Personnel Service, Inc.

THESE items are from information furnished by the Engineering Societies Personnel Service, Inc., in co-operation with the national societies of Civil, Electrical, Mechanical, and Mining and Metallurgical Engineers. This Service is available to all engineers, members or nonmembers, and is operated on a nonprofit basis.

In applying for positions advertised by the Service, the applicant agrees, if actually placed in a position through the Service as a result of an advertisement, to pay a placement fee in accordance with the rates as listed by the Service. These rates have been established in order to maintain an efficient nonprofit personnel service and are available upon request. This also applies to registrant members whose availability notices appear in these columns. Apply by letter, addressed to the key number indicated, and mail to the New York office.

When making application for a position include six cents in stamps for forwarding application to the employer and for returning when necessary. A weekly bulletin of engineering positions open is available at a subscription of $3.50 per quarter or $12 per annum for members, $4.50 per quarter for nonmembers, payable in advance.

New York
8 West 40th St.

Chicago
84 East Randolph St.

Detroit
100 Farnsworth Ave.

San Francisco
57 Post St.

## Men Available[1]

**Production Management–Industrial Engineering;** BME, MSIE; 32; 6½ years' experience in light industries. Methods, systems and procedures, material handling, production control, personnel. Strong administrator and supervisor. Will relocate. Me-282.

**Technical Executive;** mechanical graduate; advanced degree, 20 years' experience; can direct department or assist top executive. Broad interests in design, development, research, and technical planning or analysis, light to heavy mechanical products and related fields. Me-283.

[1] All men listed hold some form of ASME membership.

## Positions Available

**Industrial Engineer,** industrial degree, or mechanical degree with industrial option, minimum of five years' varied experience, for major investigations culminating in full recommendation in all phases of company operations, both manufacturing and office; full methods and production studies; departmental operations; material-handling methods; job evaluation and salary administration; statistical analysis as required; future development of incentive coverage. $7200–$8400, to start. Conn. W-2610.

**Engineers.** (*a*) Assistant secretary, mechanical graduate, under 35, some knowledge of heating, air conditioning, refrigeration, air cooling, etc., to work with society's sections, membership, etc. Some ability to write desirable. Some travel. Salary open. (*b*) Assistant technical secretary, mechanical graduate, young, for editorial work on magazine and handbook. Should have had some experience in heating, air conditioning, etc. Some travel. Salary open. East. W-2617.

**General Manager,** Cylinder-Gas Sales Division, for company engaged in the sale of industrial gases, including oxygen, nitrogen, argon, hydrogen, helium, and special mixtures. Must have management qualifications with a sales background, particularly in the industrial gas field. About $12,000. Pa. W-2623(*a*).

**Group Leader** to head up group on introduction of American methods in foreign industry. Experience in production in metal-fabricating plants. $12,000–$15,000. Finland. F-2625.

**Engineers.** (*a*) Mechanical engineer, three to five years' production experience for manufacture of hard-fiber cordage used in making rope, baler and binder twine, and commercial binder twines. $6000–$6500. La. (*b*) Mechanical engineer, three to five years' production experience, for a paper twisting plant producing paper-carpet yarns and other special twisted paper products. Familiar with manufacture of paper of various kinds and grades. $6000–$6500. Va. W-2626.

**Industrial Engineer,** 29–35, graduate degree, five years' experience in manufacturing or industrial engineering with knowledge of costs, accounting, or marketing analyses for industrial management company. $8000–$10,000. Ohio. W-2637.

**Instructor in industrial engineering,** capable of starting and teaching courses in industrial engineering on the undergraduate level in a regular degree program of mechanical engineering. Should be active in technical and professional organizations. Salary and academic rank open depending upon degree and experience. Position starts September, 1956. Ohio. W-2641.

**Industrial-Relations Manager,** 35–45, graduate engineer, some law-school and business-school training. Should have some experience in union-labor negotiations for large multiplant heavy-equipment manufacturer. To $20,000. Headquarters, New York, N. Y. W-2642.

**Engineers.** (*a*) Project design engineers, 35–50, engineering degree, at least ten years' mill design and engineering experience in ferrous and nonferrous fields covering furnaces, mills, metallurgical and chemical processes, materials handling, or other mill facilities. $8400–$15,000. (*b*) Assistant project engineers, young, engineering degree, to prepare engineering drawings covering plant and equipment layout and assist project engineers on general design. $4800–$8400. West Coast. W-2653.

**Plant Manager** to direct, appraise, and control the manufacture of company products and obtain the maximum utilization of facilities, including gray iron foundry, stainless-steel welding department, machine shop, wood shop (including patternmaking), and roll shop. Will supervise methods, standards and inspection, production schedules, quality improvement, cost reduction, stores department, shipping, and receiving department. Mass. W-2656.

**Management Engineer,** 28–33, college graduate, for the permanent staff of one of the oldest management-consulting firms. Sound background in production planning and control, methods improvement, plant and equipment layout, materials handling. Reasonable travel. $7000–$12,000. New York, N. Y. W-2658.

**Design Engineer,** at least five years' experience on automatic, packaging, or special machinery for large paper-converting manufacturer. $7000–$9000. Pacific Northwest. W-2661.

**Instructor or Assistant Professor** for industrial-engineering staff. Experience in industrial organization, motion study, time study, plant layout, production control, and engineering economics. Salary: Instructor, $3840; assistant professor, $4680 for ten months. New England. W-2665.

**Assistant Secretary** for national engineering society. Preferably engineering graduate but not mandatory. Duties involve co-ordination of all membership promotion, section formation, and sectional programs in all phases. Aptitude and genuine interest in society work a requisite. Some traveling involved. Headquarters, New York, N. Y. W-2666.

**General Manager,** 35–40, industrial engineering, production planning, managerial, and cost-analysis experience in dress goods or allied textile fields for small manufacturing firm. $10,000–$12,000. New York, N. Y. W-2675.

**Assistant to Head of Research and Development,** to 50, graduate mechanical engineer, about ten years' experience in the design of special machinery; heavy-machinery experience helpful. Some supervisory experience required. To $15,000 a year, plus benefits. Fee open to negotiation. Conn. W-2686.

**Maintenance Superintendent,** 30–45, ME or EE degree or practical equivalent. Experience in all phases of maintenance supervision in an industrial plant. Knowledge and experience in planned preventive maintenance rather than trouble shooting highly desirable. Must have sufficient practical background to be able to instruct personnel in the mechanics of equipment and plant maintenance. Salary open. Ohio. W-2689.

**Instructor,** mechanical, for descriptive geometry and mechanical drawing. Salary depending upon education, background, and experience. South. W-2695.

**Chief Standards Engineer,** college graduate, or equivalent in experience, five years' experience in time study and establishing standard-time data in machining and sheet-metal industry. Will supervise establishing of standard-time data on varied medium-heavy machining, sheet-metal fabrication, welding, and assembly operations. Assist in estimating of labor costs on new products. Make recommendations to manufacturing for improving methods and processes. Develop methods of simplifying application of standard-time data for labor-cost use. Midwest. W-2700.

**Mechanical Engineer,** graduate, three or four years' progressively responsible experience in a large plant maintenance and engineering organization, for the design and estimates for all revisions to interior heating, ventilating, air conditioning, refrigeration systems, steam distribution systems, and plumbing. Upstate N. Y. W-2709.

**Project Engineer,** graduate mechanical, 35–45, to organize and follow through a number of large expansion projects for multiplant process manufacturing company. Some field construction experience desirable. $16,000. Northern N. J. W-2713.

**Maintenance and Design Engineer,** 45–55, to work under the direction of the plant manager and in co-operation with the maintenance department. Care for preventive maintenance alteration of design, improvement of equipment, and methods customarily found in a printing plant where magazines and telephone directories are manufactured. The equipment includes flat-bed, rotary and sheet-fed rotary presses, inserting machines, gathering machines, cutters, materials-handling equipment, etc. $10,000. Upstate N. Y. W-2715.

**Vice-President of Manufacturing,** 35–50, production-management experience covering metal stampings, die castings, and plastics for novelty and industrial fields. Knowledge of styling and marketing desirable. $20,000–$30,000. New York metropolitan area. W-2719.

**Recent Engineering Graduate,** to 30, to work for large electric-power utility on layout of fire-protection systems for generating stations, substations, and office and service buildings. Experience desired but not essential. Apply by letter giving education, experience, and references. Some travel. New York, N. Y. W-2722.

**Senior Engineer,** BS in ME, seven to ten years' experience in machine, heavy structure, or tool design. Will be responsible for mechanical aspects of industrial instruments. Mass. W-2724(*b*).

**Engineers.** (*a*) Assistant chief industrial engineer, to 45, engineering graduate, ten to 15 years' experience in industrial engineering, and tooling, manufacturing, methods, work measurement, and incentives. Experience with medium-sized capital equipment helpful. $9144–$10,296. (*b*) Chief tool engineer, engineering graduate, a mimimum of ten years' tooling experience including tool design and estimating. Capable of supervising tool design, patternmaking, and tool room for manufacturer of a wide range of tools, all types of machine-tool equipment. $7,212–$8,124. New York metropolitan area. W-2737.

**Managers.** (*a*) Service manager, a degree in engineering; eight to ten years' experience in industry, at least five of which were spent in service-department operations of an appliance manufacturer, to conduct the service program of a consumer-goods division producing air-conditioning products, both electrical and gas-fired. Must be capable of developing warranty policy and programs. Must oversee service bulletins, service training, etc. To $9000. Ind. (*b*) Public-relations manager, college degree desirable; some experience in writing, both house organ and product publicity. Experience in community-relations work desirable. Will conduct community and plant-relations work for a multiple-plant division; oversee plant newspaper, prepare product publicity material; act as liaison between the corporation and civic officials; represent corporation in local industrial and trade groups. To $10,000. Ind. (*c*) Advertising manager. Must have industrial advertising experience in appliance field. Will be responsible for developing and executing the entire advertising program, product-publicity material, and assistance to sales-training programs. To $10,000. Ind. W-2739.

**Assistant or Associate Professor** in industrial engineering, capable of teaching quality control and plant layout and materials handling. Position available fall of 1956. $4600–$5600. South. W-2740.

**Building-Maintenance Engineer,** under 50, mechanical graduate, at least five years' maintenance and supervising operations and alteration experience of commercial buildings. $7000. Philadelphia, Pa. W-2745.

**Chief Industrial Engineer,** ten years' experience in industrial engineering. Experience should be strongest in the field of methods, time-and-cost analysis, plus the establishment and administration of incentive plans for glass-manufacturing plant. $7500. N. J. W-2754.

**Methods Engineer,** industrial-engineering graduate, office-procedure, cost-analysis, and methods-improvement experience in institutional administration. $6000–$8000. Mass. W-2755.

**Plant Engineer,** mechanical-engineering training with maintenance experience, to establish standards, policies, and operating procedures for efficient performance. Inspect and maintain equipment in accordance with sound engineering principles and safety regulations. Test newly installed machinery and equipment to insure fulfillment of contract specifications. $5500–$6500. New England. W-2756.

**Sales Engineer,** electrical or mechanical graduate, to 35, at least seven years' experience, five of which should have been in engineering and two in sales. Knowledge of electronics desired. Will be responsible for sales of transducers, gyroscopes, analog computers, aircraft, and guided missiles. Must have solid experience with servomechanisms, aircraft controls, fire control, bombsights, telemetering, etc. 50 per cent traveling and home week ends. Car desirable. $6500–$9000, plus expenses and incentive. Employer will negotiate fee. Headquarters, Chicago, Ill. C-4128.

**Department Manager, Aircraft-Production Laboratory,** degree or equivalent, 35–45, three years' experience testing supervision. Should be qualified to head up a testing program. Duties will include planning, initiating, directing, and carrying out test programs; organize and administer testing laboratory so it will function 24 hours a day, seven days a week; plan budgets, facilities, and reports. Company manufactures heaters. $10,000. Employer will pay fee. Ind. C-4261.

**Sales Engineer,** precision gears, to 45, graduate mechanical, at least four years' experience in sales of gears to O.E.M.'s and industry. Will sell line of high-precision gears to aircraft and aircraft-component industries. Car required; traveling. $10,800, plus bonus and P.S. Employer may pay fee. West Coast. C-4264.

**Industrial-Furnace Designer,** mechanical graduate, to 45, experience in the design of gas-fired industrial furnaces, for the design of this equipment. $8400, plus bonus, plus P.S. Employer may pay fee. Calif. C-4266.

**Chief Electromechanical Engineer and Electromechanical Engineer,** to 40, electrical or mechanical graduate, experience in the design of electromechanical components in manufacturing company on products such as gyros, accelerometers, potentiometers, etc. Will design products for manufacturer. Chief engineer will supervise five or six engineers. Salaries: Chief engineer, to $14,000; electromechanical engineer

(*ASME News continued on page 208*)

# YARWAY picked for "Preferred" Steam Generators

This installation of Preferred Utilities Mfg. Corp. packaged unit steam generators at a high school in New York State features YARWAY Blow-Off Valves as part of the "package".

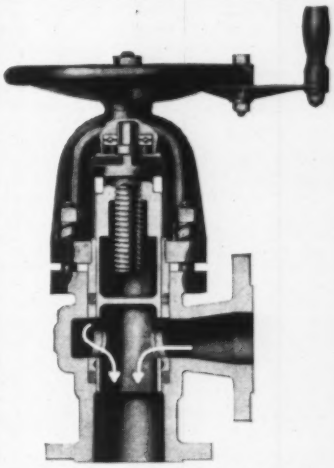
Not only Preferred Utilities, but many other leading manufacturers of package-type boilers now furnish YARWAY Blow-Off Valves on their units. YARWAYS make a *good* package boiler *better*.

The YARWAY Seatless Valve gives drop-tight shut-off and also eliminates the commonest source of blow-off valve trouble. *There is no seat to score, wear, clog or leak.*

Whatever make boiler you use, specify that the blow-off valves be YARWAY *Seatless*. More than 16,000 boiler plants use YARWAY Blow-Off Valves—some for 35 to 40 years.

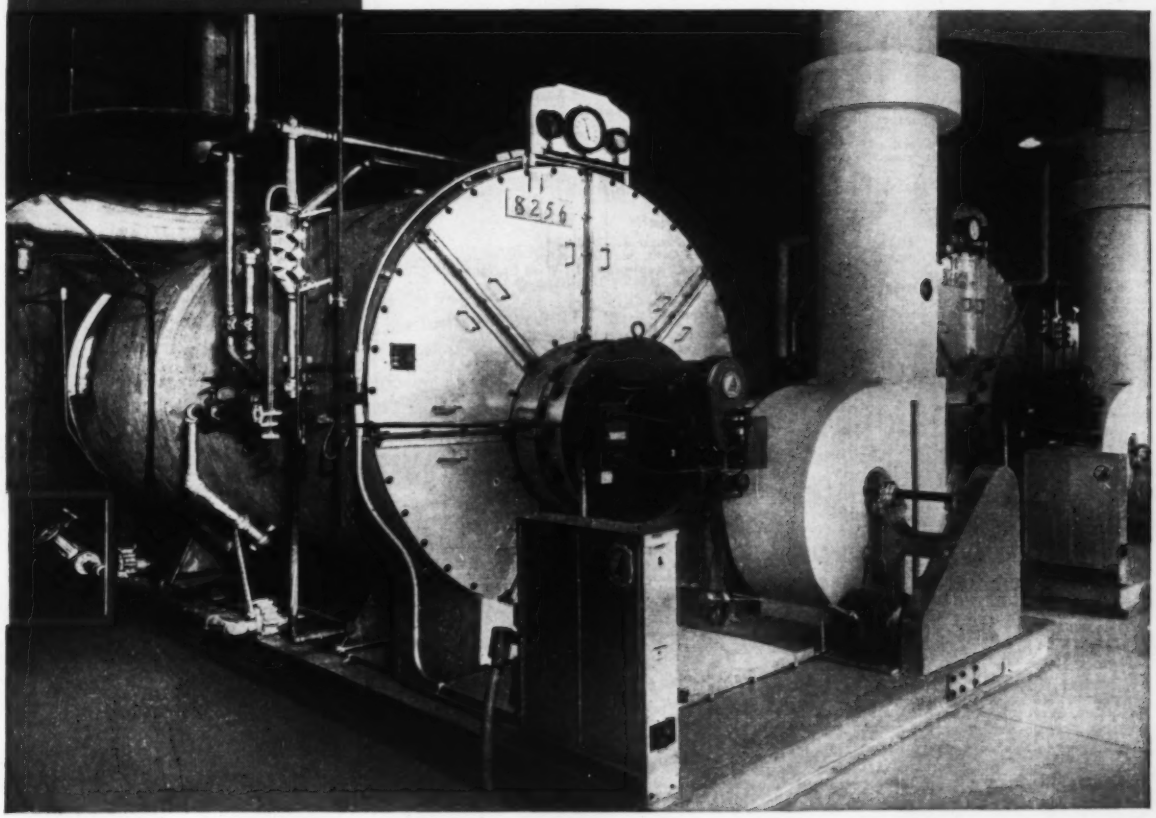
Write for full details in Yarway Bulletin B-426.

**YARNALL-WARING COMPANY**
108 Mermaid Ave., Philadelphia 18, Pa.
BRANCH OFFICES IN PRINCIPAL CITIES



Yarway Type "B" Seatless Blow-Off Valve shown in open position. Note balanced, sliding plunger design. There is no seat to score, wear, clog or leak. Pressures to 400 psi.

YARWAY **BLOW-OFF VALVES**



to $9600. Employer will possibly pay fee. Calif. C-4267.

**Tooling Engineer,** to 40, at least five years' experience in supervising tooling operations in plastics or die-casting industry. Knowledge of tools, dies, and moldmaking. Will supervise tool-room activities, estimating jobs, recommend tooling and molds, co-ordinate all tooling and moldmaking functions and make both inside and outside contacts on tooling problems. Manufacturer of molded plastic parts. $10,000–$12,000 a year. Employer will negotiate fee. West Chicago, Ill., suburb. C-4287.

**Design, Development, and Project Engineer,** electrical or mechanical graduates, to 55; will consider recent graduates; knowledge of electronics, communications, and/or mechanical products in communications field. Will design, develop, test, do drafting, analyzing, or field work on relays, transistors, control-station telephone equipment, and allied accessories. Company manufactures switchboards. To $9600, depending on experience. Employer will pay fee. Chicago, Ill. C-4289.

**Lubrication Engineer,** mechanical graduate, to 35, at least two years' experience in plant engineering, and preferably in some lubrication capacity. Knowledge of lubrication and petroleum products. Will assist in plant-engineering work at first and later work into lubrication work. $5400–$7200. Employer will pay fee. Chicago, Ill. C-4300.

**Project Engineer,** mechanical graduate, to 45, at least three years' experience in project work on fast-moving machinery such as packaging, printing, or paper-folding equipment. Knowledge of printing helpful. Will do project work in design, maintenance, and installation of very-fast-moving light-automatic machinery. Company manufactures paper products. To $10,000. Employer will negotiate fee. Chicago, Ill. C-4346.

**Trainees, Electrical or Mechanical Graduates;** knowledge of nuclear physics desirable. Will train in electrical-engineering department or in steam-electric generating station. The latter position will eventually be in nuclear-power group. $4400. Ill. C-4371.

**Teaching Personnel,** mechanical. One man for mechanics and one in heat-power field. Teaching and industrial experience desirable. Graduate work available. $4000–$5000 for nine months. N. Dak. C-4377.

# Candidates for Membership and Transfer in ASME

THE application of each of the candidates listed below is to be voted on after Feb. 24, 1956, provided no objection thereto is made before that date and provided satisfactory replies have been received from the required number of references. Any member who has either comments or objections should write to the Secretary of The American Society of Mechanical Engineers immediately.

## New Applications and ●Transfers

### *Arizona*

POLENSKE, RICHARD E., Phoenix

### *California*

CHAMBERLIN, ROBERT S., Millbrae
●FALCON, JOSEPH A., Los Angeles
FINNIE, IAIN, Emeryville
KLAUBER, PHILIP M., San Diego
MCADAMS, JOHN W., San Francisco

### *Colorado*

JACOBSEN, ROBERT L., Denver
WILSON, WILLIAM A., Boulder
WINTER, ISRAEL A., Denver

### *Connecticut*

●CAWL, ALLEN P., Noroton Heights
CRABILL, PRESTON R., Hartford
IZZO, LAWRENCE L., Bridgeport
JEFFRIES, ROBERT J., Ridgefield
●MCFARLAND, MILTON C., Groton
NEUENDORFFER, RICHARD, New London
PAWLINA, EDMUND F., Hartford
●SCHNEIDER, GERHART R., Hamden

### *Delaware*

EDWARDS, HARRY M., Wilmington
WYETH, NATHANIEL C., Wilmington

### *District of Columbia*

HOWARD, DARNLEY M., Washington
KLEIN, AUGUST S., Washington
TORRE, COSIMO, Washington

### *Florida*

ANTONACCI, DONALD W., Pensacola
BROWN, THOMAS R., Pensacola
SLOAN, LEWIS T., Jacksonville
THOMAS, WILLIAM M., Miami

### *Illinois*

BRADFORD, ROLLAND H., Chicago
FRAZIER, GORDON R., East Alton
GOLBER, MYRON B., Chicago
KILCOIN, JOHN A., JR., Bloomington
LUCAS, LOUIS J., Chicago
SEMRAU, FRANK, Chicago
SMITH, JAMES T., Chicago
STEELE, MONTGOMERIE C., Urbana
TENNEY, GLENN G., Downers Grove

### *Indiana*

BEIER, KURT A., Morgantown
BEYER, ARNOLD J., Gary
GROSH, RICHARD J., West Lafayette
SKULSKI, RICHARD W., Fort Wayne

### *Kentucky*

HARAGAN, ROBERT M., Louisville
ZIMLICH, JOSEPH A., JR., Louisville

### *Louisiana*

RUTLEDGE, BARBARA B., New Orleans

### *Maryland*

HAY, CLINTON W., JR., Baltimore
HILDEBRANDT, JOHN B., Baltimore
JONES, JOHN F., Baltimore

### *Massachusetts*

FOX, KENNETH R., Dedham
GEIGER, KARL A., Cambridge
LINDAHL, FREDERICK M., West Springfield
WHITCOMB, HENRY B., Somerset

### *Michigan*

ANDERSON, DONALD E., Saginaw
ATKINSON, JOHN E., Jackson
●CLARY, EDWARD L., Flint
KOCH, ARNO, Detroit

### *Missouri*

KORSAN, WILLIAM E., St. Louis
KOSTECK, BERNARD A., St. Louis
MERCK, JOHN, Kansas City
SCHROETER, CHARLES G., JR., St. Charles

### *New Jersey*

GOGLIUCCI, ANTHONY, Wharton
HEIM, RUSSELL H., Roselle Park
KOHLER, SAMUEL H., Collingswood
MAAG, PAUL W., Trenton
●RUSH, JOHN E., Phillipsburg
SWORD, EDWARD C., Jersey City
VAN PELT, STANLEY M., Nixon

### *New Mexico*

TUTTLE, ROGER N., Albuquerque

### *New York*

BOUSMAN, HENRY W., Scotia
●CARVIN, PHILIP J., Flushing
CONNORS, WILLIAM D., Elmira
DAVIS, THOMAS A., JR., Tonawanda
DZELZKALNS, RAIMONDS V., Port Washington
FADEM, RICHARD J., Valley Stream
FOSTER, EDWARD E., Buffalo
FOX, EDWARD A., Troy
GORDON, HENRY R., Williston Park
KELLEY, ROY D., Kenmore
MURRAY, GEORGE J., Hampton Bays, L. I.
OLMAN, GARY S., Bellerose
PESEK, VICTOR G., New York
ROSENTHAL, MYRON M., Woodside
SANDORE, HENRY P., JR., Elmira
SENSENBAUGH, JAMES D., New York
SHERMAN, ROGER J., New York

### *North Carolina*

FUSCH, OTTO A., Charlotte
KEISTER, FRANK Z., Winston-Salem
●WILBUR, LESLIE C., Hillsboro

### *Ohio*

BAILLIE, WALLACE E., Cleveland
GOODWIN, RALPH C., Hamilton
KOLHOFF, RICHARD C., Toledo
KYMER, RICHARD F., Mount Vernon
MARKANT, HENRY P., Alliance
MCGAFFICK, CARL J., Salem
RUFF, RICHARD O., Toledo
SMITH, GARLIN L., Cincinnati
TREECE, JESSE H., Toledo
WHEELER, HARRY B., Toledo

### *Oklahoma*

BEESON, CLEMENT T., JR., Tulsa

### *Oregon*

BOUBEL, RICHARD W., Corvallis

### *Pennsylvania*

FERIDUN, KEMAL K., Easton
FERRERO, ROBERT R., JR., Pittsburgh
POTTHOFF, EDWARD C., JR., Erie
●RONDEAU, HERBERT F., Elkins Park

### *Rhode Island*

GWIN, ROBERT C., JR., Barrington
KESTIN, JOSEPH, Providence
MURPHY, MAURICE V., JR., Hope Valley
SMALL, THEODORE M., Providence
●WORMSER, HANS H., East Greenwich

### *Texas*

●BELL, HOWARD F., Bellaire
●FRANZ, DONALD C., Houston
HALE, ALBERT D., Dallas
●KRUSEMARK, FRED D., Dallas
TINGLEY, LAWRENCE H., Houston

### *Virginia*

SCHIRMER, JOSEPH E., Portsmouth

### *Washington*

BROWN, JOHN W., Richland
PEDERSEN, LESTER T., Richland
PRIEBE, O. WILLARD, Richland
SEBADE, DALE E., Richland
SHAVER, BENJAMIN, Richland

### *Wisconsin*

DAANE, ROBERT A., Beloit
NICHOLS, BEVERLY R., Wauwatosa
PETERSON, MERTON W., Whitewater

### *Foreign*

DELEFORTRIE, MICHEL E., Brussels, Belgium
DUPLESSIS, JAN L. C., East Pretoria, S. Africa
●HAYEK, ANTHONY G., Stoke on Trent, England
HENNING, ROBERTO A., Buenos Aires, Argentina
HOWARD, BARRY A., Scarborough, Ont., Can.
VELASCO, GERONIMO Z., Manila, Philippines

*Transfers from Student Member to Associate Member* ..... 34

● Transfer to Member or Affiliate.

# Obituaries

**Juan Antonio Almirall (1870–1955),** former president, Almirall & Company, New York, N. Y., died Oct. 26, 1955. Born, Brooklyn,

(*ASME News continued on page 210*)

# IRVING GRATINGS UNEXCELLED From Every Angle!

## Engineering-Wise:

1. Irving *specializes* in the manufacture of *all types* of gratings. Irving engineers are prepared to handle any grating problem, no matter how complicated (such as proper fit, unusual conditions of stress, corrosion, etc.).
2. Complete pre-order service by Irving estimating staff includes prompt, accurate recommendations and quotations. All orders are checked by engineers with years of specialized experience.
3. Comprehensive drafting organization assures precision manufacture plus uninterrupted flow of production; accurate erection drawings supplied with every order.
4. Prior to shipment gratings are carefully inspected for conformity to specifications and to Irving high standards of quality.

## Economy-Wise:

- Precisely fabricated panels make installation easier, faster.
- Costly mistakes are avoided by utilizing up-to-date engineering skill and valuable experience unique with Irving.
- Irving quality gratings require minimum maintenance.
- Irving reputation of over 50 years of customer satisfaction is your guarantee of effective grating application.

## Performance-Wise:

**Non-skid; fireproof**

**Strong; self-draining**

**Self-ventilating; durable**

**Irving ALUMINUM Gratings- rustproof, sparkproof, lightweight**

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Write today for our illustrated catalog containing engineering data on Irving Riveted, Welded and Press-locked gratings that will save you time and money!

N. Y., Nov. 25, 1870. Parents, Joseph J. and Ida M. Almirall. Education, BS(ME), Cornell University, 1891; MS(ME), Cornell University, 1892. Married Emma Kuntz, 1906. Jun. ASME, 1892; Mem. ASME, 1904. Survived by wife; two children, Juanita and Lloyd V. Almirall.

**Herbert J. Brawner (1923–1955),** application engineer, Gates Rubber Co., Denver, Colo., died sometime in 1955, according to information received by the Society. Born, Livingston, Mont., Jan. 9, 1923. Education, BS(ME) Montana State College, 1947. Assoc. Mem. ASME, 1947.

## Keep Your ASME Records Up to Date

ASME Secretary's office in New York depends on a master membership file to maintain contact with individual members. This file is referred to dozens of times every day as a source of information important to the Society and to the members involved. All other Society records and files are kept up to date by incorporating in them changes made in the master file.

From the master file are made the lists of members registered in the Professional Divisions. Many Divisions issue newsletters, notices of meetings, and other materials of specific interest to persons registered in these Divisions. If you wish to receive such information, you should be registered in the Divisions (no more than three) in which you are interested. Your membership card bears key letters opposite your address which indicate the Divisions in which you are registered. Consult the form on this page for the meaning of the letters. If you wish to change the Divisions in which you are registered, please notify the Secretary's office.

It is important to you and to the Society to be sure that your latest mailing address, business connection, and Professional Divisions' enrollment are correct. Please check whether you wish mail sent to home or office address.

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Date

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POSITION TITLE | NATURE OF WORK DONE
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NAME OF EMPLOYER (Give complete name in full) | Division, if any

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| ☐ H—Hydraulics | ☐ Q—Nuclear Engineering | |

**Henry Bernhard Dirks (1884–1955),** dean of engineering, Michigan State College, East Lansing, Mich., died Sept. 18, 1955. Born, Chicago, Ill., June 21, 1884. Parents, Herman J. and Anna (Meyer) Dirks. Education, BS-(ME), University of Illinois, 1904; ME, University of Illinois, 1905. Married Blanche Breckenridge, 1912; two children, Henry B., Jr., and Anna E. Author of bulletins for Illinois Engineering Experimental Station. Jun. ASME, 1907; Assoc-Mem. ASME, 1916; Mem. ASME, 1930; Fellow ASME, 1946.

**Herbert William Dow (1878–1955),** executive sales manager, Norberg Manufacturing Co., Milwaukee, Wis., died Aug. 19, 1955. Born, Milwaukee, Wis., Jan. 24, 1878. Parents, William H. and Hannah E. Dow. Education, BS(ME), University of Wisconsin, 1902. Married Ora Edgett, 1904; three children, James E., Herbert W., Jr., and Hannah I. Mem. ASME, 1917.

**Erwin E. Franz (1893–1955),** engineer, Western Electric Co., Inc., Kearny, N. J., died Oct. 21, 1955. Born, Brooklyn, N. Y., May 25, 1893. Education, private tutor. Mem. ASME, 1930.

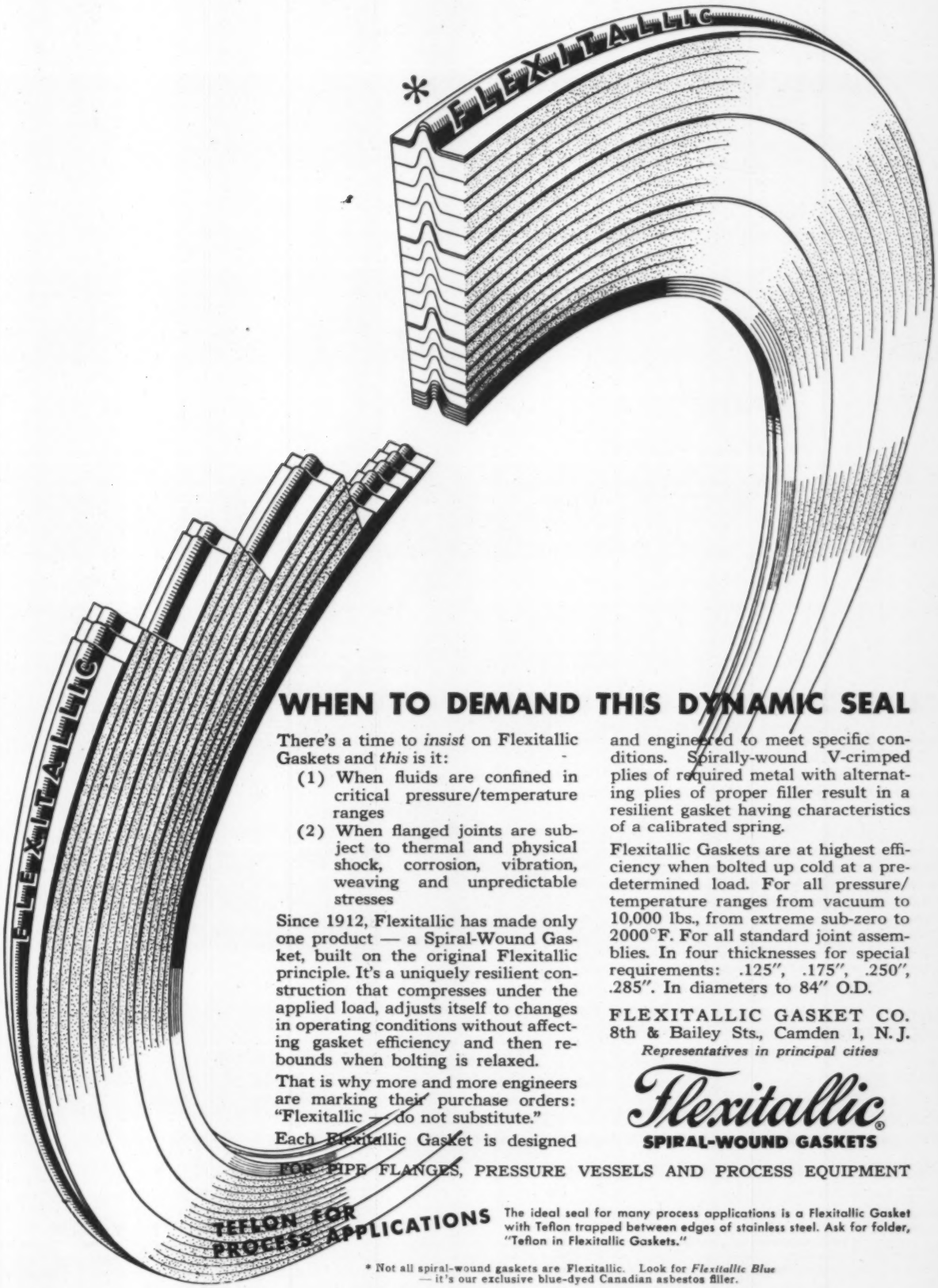
**Arthur Graham Glasgow (1865–1955),** chairman, Humphreys & Glasgow, Ltd., London, England, died Oct. 28, 1955. Born, Buchanan, Va., May 30, 1865. Parents, Francis T. and Anne (Gholson) Glasgow. Education, ME, Stevens Institute of Technology, 1928; Honorary degrees, DS, Washington & Lee University, 1930; LLD, Wabash College, 1950. Married Margaret Branch, 1901. Received Alumni Award from Stevens Institute of Technology, 1951. Awarded Rhodes Medal by Virginia Museum of Fine Arts (with wife), 1952. Held many patents in field of gas technology. Author of numerous articles and Series Letters Concerning Better Government. Author of brochure, "Making Democracy and the World Mutually Safe." Mem. ASME, 1892.

**Roy Stevenson King (1876–1955),** retired head, department of mechanical engineering, Georgia School of Technology, Atlanta, Ga., died Nov. 7, 1955. Born, Xenia, Ohio, Sept. 10, 1876. Parents, William H. and Bertha (Ritter) King. Education, BS(ME), Ohio State University, 1902; MS, University of Minnesota, 1907. Married Estella Peterson, 1903; died 1952. Awarded honorary degree of Doctor of Science by University of Georgia, 1922. Author of many short articles for technical press. Jun. ASME, 1904; Mem. ASME, 1910; Fellow ASME, 1949. Survived by a sister, Mrs. Edwin Fitzgerald; and a niece, Mrs. Roger Bacon.

**Edward Carl Magdeburger (1886–1955),** head engineer, technical adviser, Diesel Engines, Bureau of Ships, Navy Dept., Washington, D. C., died Oct. 11, 1955. Born, Tambov, Russia, Jan. 1, 1886. Parents, Johann H. and Henrietta (Asmus) Magdeburger. Education, ME, Institute of Technology, Leningrad, Russia, 1909. Naturalized U. S. citizen, May, 1916. Married Elviria Zimmermann, 1913; four children, Kathryn, Paul, Alice, and Robert. Held U. S. Patents covering scavenging system for two-cycle diesel engines; supercharging valve for two-cycle diesel engines; design of wrist-pin bearing for elastic-power transmitting devices. Author of "Diesel Engines in Submarines," 1925; "The Modern Oil Engine," 1926; "Diesel Engines for the Navy," 1927; "High-Speed Oil Engines," 1930; and others. Assoc-Mem. ASME, 1917; Mem. ASME, 1920. Served as secretary-treasurer, Washington, D. C., Section ASME, 1926–1927. Served as chairman, Washington, D. C., Section ASME, 1927–1928.

**Lewis Chubb Rogers (1876–1955),** consulting engineer, Wolverine Shoe & Tanning Corp., Rockford, Mich., died April 14, 1955. Born, Grand Rapids, Mich., Oct. 29, 1876. Parents, Erwin M. and Jessie (Chubb) Rogers. Education, BS(ME), University of Michigan, 1904. Married Helen Brimmer, 1896; one son, Erwin Milton. Mem. ASME, 1912. Served on ASME Code for Evaporator Testing for 10 years.

**Robert Jay Shoemaker (1883–1955),** consulting engineer, Magnus Metal Division, National Lead Co., Chicago, Ill., died May 25, 1955. Born, Knox, Pa., Nov. 5, 1883. Parents, Geor.: G. and Mary C. (Longnaker) Shoemaker. Education, attended Temple University, 1902; BS, University of Pennsylvania, 1907. Married Helen Regina Donahue, 1939. He held patents relating to refrigerator-car insulation materials; lead-plating processes; bearing metals and bearings. Inventor of Satco Bearing Metal; journal lubricator devices. Mem. ASME, 1946. Survived by wife and son, Robert W., Troy, N. Y.




# WHEN TO DEMAND THIS DYNAMIC SEAL

There's a time to *insist* on Flexitallic Gaskets and *this* is it:

(1) When fluids are confined in critical pressure/temperature ranges

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Since 1912, Flexitallic has made only one product — a Spiral-Wound Gasket, built on the original Flexitallic principle. It's a uniquely resilient construction that compresses under the applied load, adjusts itself to changes in operating conditions without affecting gasket efficiency and then rebounds when bolting is relaxed.

That is why more and more engineers are marking their purchase orders: "Flexitallic — do not substitute."

Each Flexitallic Gasket is designed and engineered to meet specific conditions. Spirally-wound V-crimped plies of required metal with alternating plies of proper filler result in a resilient gasket having characteristics of a calibrated spring.

Flexitallic Gaskets are at highest efficiency when bolted up cold at a predetermined load. For all pressure/temperature ranges from vacuum to 10,000 lbs., from extreme sub-zero to 2000°F. For all standard joint assemblies. In four thicknesses for special requirements: .125", .175", .250", .285". In diameters to 84" O.D.

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**SPIRAL-WOUND GASKETS**

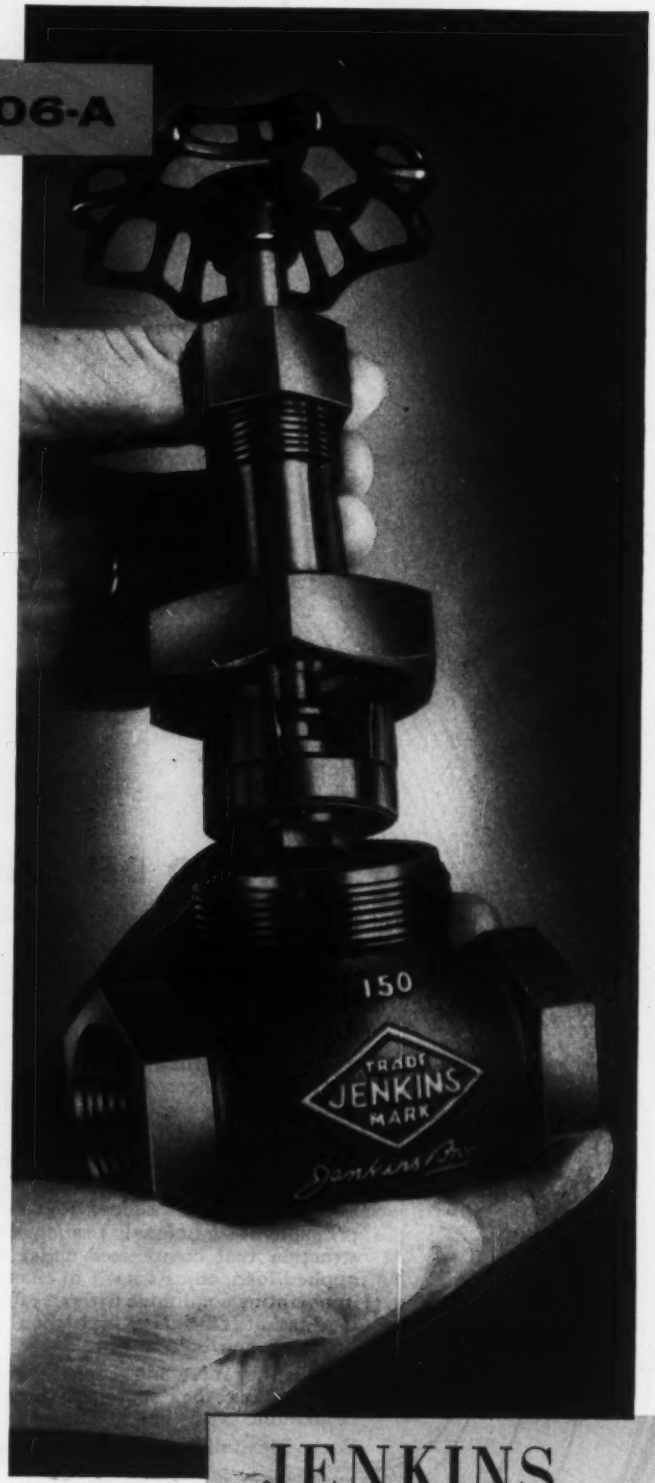
FOR PIPE FLANGES, PRESSURE VESSELS AND PROCESS EQUIPMENT

**TEFLON FOR PROCESS APPLICATIONS** The ideal seal for many process applications is a Flexitallic Gasket with Teflon trapped between edges of stainless steel. Ask for folder, "Teflon in Flexitallic Gaskets."

* Not all spiral-wound gaskets are Flexitallic. Look for *Flexitallic Blue* — it's our exclusive blue-dyed Canadian asbestos filler.

# JENKINS Fig. 106-A

**The FIRST**
**Renewable Composition Disc**
**BRONZE GLOBE VALVE**
**150 lbs. Steam 300 lbs. O.W.G.**
**⅛ in. to 3 in.**




## Making a Work Horse a Champion

Take a Fig. 106-A apart. It's easy to see the reason why it's the "champion" of disc-equipped Bronze Globes. Every part, from heatproof handwheel to pipe ends, reflects the design and construction skill of generations of Jenkins Valve specialists.

Jenkins Bros. introduced the first renewable composition disc Globe . . . is still the only manufacturer of both valves *and* discs.

Fig. 106-A not only looks better — it proves out better in performance. In any comparison, its long-life, low-upkeep record has always set the standard. That is the true measure of valve cost — and it is the reason why industry's shrewdest buyers will settle for nothing less than Fig. 106-A quality.

The Fig. 106-A "family", with interchangeable parts, provides Globe, Angle, and Check patterns to meet 90% of average valve needs.

Ask your Jenkins Distributor for full information, or write: Jenkins Bros., 100 Park Ave., New York 17.

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VALVES
SINCE 1864 TRADE JENKINS MARK
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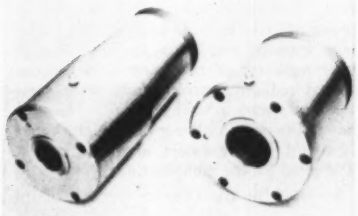
**Available literature or information may be secured by writing direct to the manufacturer. Please mention MECHANICAL ENGINEERING**

## NEW EQUIPMENT



### Milling Machine Bushing

Live bushings designed to replace bronze bushings in the outboard support of milling machines have been introduced by J. G. Jergens Div., Donley Products, Inc., 11106 Avon Ave., Cleveland, Ohio.

The company says the new bushing makes possible the maintaining of closer tolerances at higher speeds over greatly increased periods of time. The bushing is said to eliminate freezing of the arbor and to allow the use of carbide tools to full capacity on both new and old milling machines.

According to the manufacturer, the bushings incorporate an absolute seal against coolants and dirt, turn on friction free roller bearings, and are adjustable for wear to maintain close tolerance for long periods of time at higher speeds. These features, the company says, eliminate constant adjusting, tightening, and bushing replacement to maintain precision. Installation involves removing the bronze bushing and replacing it with the new bushing. No machining is necessary, the company says.

### Marking Stamps

Development of four styles of etching stamps, made from acid-resisting molded plastic, is announced by Jas. H. Matthews & Co., 3999 Forbes St., Pittsburgh 13, Pa.

The styles of stamps are as follows: peg style, for most general use, in which the plastic stamp is mounted on a rectangular or round wooden peg; dowel type, similar to the peg style with the addition of a special cap and self-contained ink pad, which fits on the stamping end; key-chain dowel style, also with a cap and self-contained ink pad, but for affixing to a key-chain; and the pocket-clip style, all-metal with a cap and ink pad, and with a pocket clip to enable the user to carry it on the person like a fountain pen.

The company says acid-etch inspection and identification marking finds great use where the part to be marked is of a delicate nature or is made from a delicate material; or where the part is odd-shaped, making it difficult to mark with conventional methods.

### Twin Cylinders

Oilgear Co., 1555C W. Pierce St., Milwaukee 4, Wis., has designed and built special twin cylinders, yoke trunnion mounted for operating the model plane support carriage in a trisonic wind tunnel.

The two cylinders have a $4^1/_2$-in. bore by 108 in. stroke. The pistons are an integral part of the $3^3/_{16}$-in. diam rams and both are chrome plated. Guides for the pistons and rams are bronze and Garlock ram wipers are in the front head. All O-rings and packings are specially designed for use with fire resistant fluid.

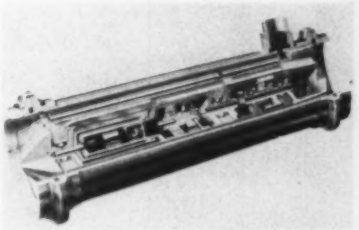
The cylinders have adjustable hydraulic cushions and decelerate 7600 lb of mass at 5 fps in 2.4 in. The net weight of this unit is 3200 lb.

### Electronic Counter

Westport Electric, 149 Lomita St., El Segundo, Calif., has announced a new model WE-120 electric counter. The unit features five decades, digital division of time base frequency, variable display time and high sensitivity, according to the company.

The firm points out that the counter is extremely compact and portable. It has a volume of less than $^1/_3$ cu ft, and features a panel 19 × $3^1/_2$ in. The unit has cold-cathode glow transfer tubes for digital presentation and simplified circuitry for economical performance, the company says.

Range of the unit is 10 to 100,000 cps, with a sensitivity of 50 mv. Count accuracy is ±1 count; display time 0.5 to 5 sec.



### Mass Flowmeter

Inertial Instruments, Inc., 2029 Broadway, Santa Monica, Calif., has introduced a mass flowmeter which operates by continuously "weighing" flowing liquid or gas. With the new unit, the company says, there is no need to know density, temperature, or viscosity.

The unit imparts a known, constant angular velocity to the fluid flowing through the meter. Then the torque required to stop the rotation is directly proportional to the mass flow and is measured by means of a calibrated spring which has a deflection proportional to the torque.

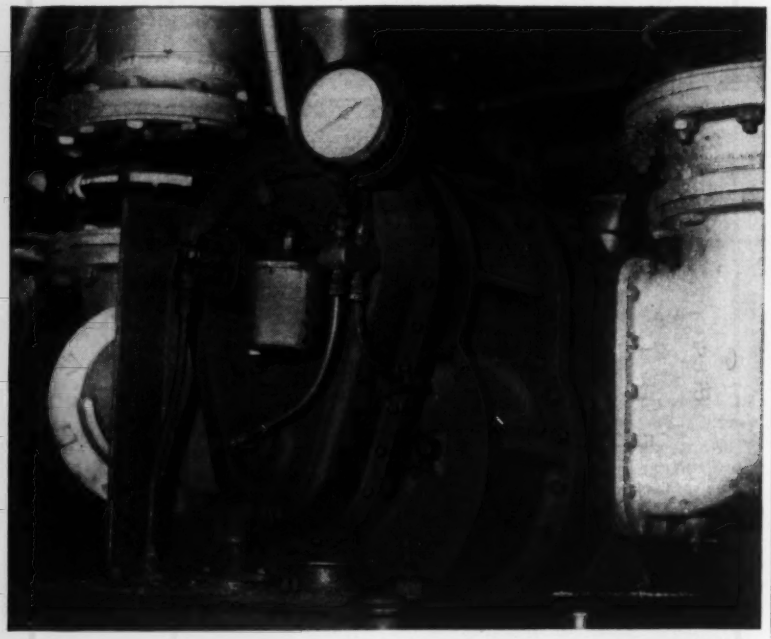
The company says this deflection, which is sensed by the signal generator, results in a voltage proportional to true mass flow rate. The flow rate signal is displayed on a dial indicator, or it can activate a digital counter. The signal may also be directed to a totalizer so that the total quantity of flow passed through the meter is measured, the company adds.

A constant speed drive in which the speed is independent of temperature, applied voltage and frequency is a feature of the unit. A readout system of the self-balancing type is available with either an analog or digital output.

### Hydraulic Accumulator

John S. Barnes Corp., Rockford, Ill., has designed and patented an accumualator featuring a unique diaphgram which is only flexed, never stretched and operates indefinitely without loss of pre-charge pressure, supplied by either nitrogen or regular air under pressure.

The flange mounted accumulator permits easy installation and can be used successfully in almost every type of production equipment, the company says. Uses cited by the manufacturer are traversing mechanisms, indexing turrets for high speed lathes, clamping, and actuating devices of all types.



## Operates 15 months at 165% overload— *not a sign of wear*

**A large eastern chemical company, requiring a continuous high volume of air, installed the 980 pound Standardaire Blower shown above to replace a 4800 pound blower of competitive manufacture.**

**This Standardaire model, a low pressure unit rated to operate at 1750 rpm and 4.5 psi, was forced to operate at 2200 rpm and 12 psi day and night, out of doors . . . for 15 months. During that time, it moved approximately 1⅓ billion cubic feet of air.**

**Disassembled to determine the effects of this gruelling run, engineers detected no discernible sign of wear. The main and gate rotors were like new. The interior was completely dry and free of oil. Axial clearance of the main rotor shaft thrust-radial bearing had increased less than 0.0005 in. Other bearings were in perfect order.**

**Reports such as this are not unusual. Standardaire Blowers installed throughout this country and others are performing under exceptional overload conditions for extended periods without maintenance other than lubrication. These units provide greater capacity per pound of blower with less power consumption than any other make. Write for complete information.**

READ STANDARD
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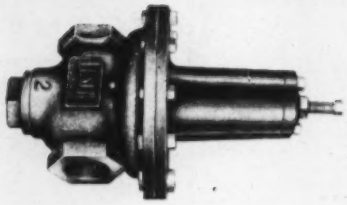

### Reducing Valves

A newly designed water pressure reducing valve has been added to its line of regulators and controllers by Leslie Co., 75 Delafield Ave., Lyndhurst, N. J.

The new classes W-1 and WL-1 valves for water and other noncorrosive liquids are known as "Hi-Flo" regulators and are said to have capacity-regulation features that no other regulator offers to provide a constant flow at reduced pressure under wide variations and surges in inlet pressure. They provide 50 per cent to 100 per cent greater capacity than other regulators, according to tests conducted by the manufacturer.

Some of the construction features of this reducing valve include large bowl construction and long travel diaphragm; full balance for smooth throttling action; high strength balancing diaphragm to eliminate less positive seals; renewable trim with interchangeable fit.

The new valves are available in ½, ¾, 1, 1¼, 1½ and 2 in. compound treated cast iron bodies. Inlet pressure range is 10-250 psi, 180 F with reduced pressure ranges of 5–30 psi on 25–80 psi. Minimum pressure drop is 5 psi.

### Strain Gages

New SR-4 resistance type strain gages for use at temperatures up to 1800 F are announced by Baldwin-Lima-Hamilton Corp., Philadelphia 42, Pa. Gages are of the etched foil type, licensed and manufactured under Technograph patents.

The new strain gages are offered for experimental use without guarantees and are available in kits including ten gages, four types of cement with different temperature limits, detailed instructions for use, and tools to simplify application.

Gages consist of an etched foil grid 0.0005 in. thick on a temporary carrier which is stripped off when applying them, leaving the grid embedded in a ceramic cement. Nichrome, Nichrome V, and Constantan grids are available in gage lengths of 1 in., ½ in., and ⅜ in. Temperature limits of the four cements are 700, 900, 1100, and 1800 F. Tests in Baldwin laboratories indicate that the gages can be used in static tests up to approximately 1100 F. Above this temperature the gages can be used only for dynamic tests. Nominal resistance of the gages is between 97 and 120 ohms. The kit includes 10 gages having resistances within plus or minus 0.2 ohm of each other.

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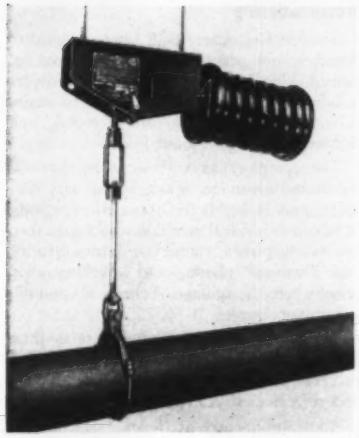


## Constant Support Hangers

Grinnell Co. Inc., 260 W. Exchange St., Providence, R. I., announces an extended line of Model R constant support hangers with load capacities from 31 to 32267 lb. The hangers are said to permit expansion and contraction of piping systems, through heating and cooling cycles, without developing dangerous stresses.

The company says the new line offers increased supporting forces or greater travel within a given frame size to provide any load or travel.

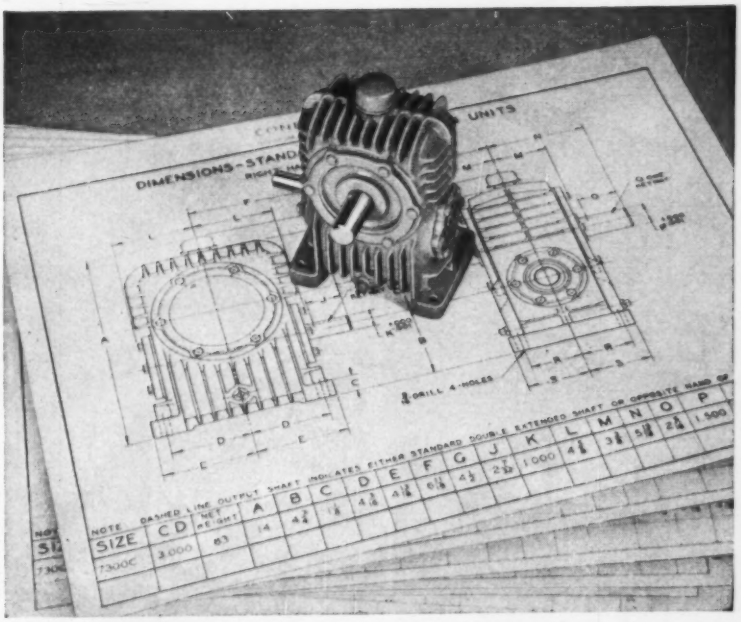
Nine frame structures available—two of them completely new. The field adjusting bolts have been relocated for easy load readjustment. The bearings have been relocated in the frames, permitting the main pivot to rotate and carry the load indicating pointer. Four of the new frame designs require less head room and permit installation closer to other structures. New stops are provided for rigidly locking the hanger in a fixed position. These stops are also used during hydrostatic tests.

## Cylinder Line

Additions to its line of small air cylinders have been announced by the Bellows Co., Akron 9, Ohio. A double-acting model (air-powered advance stroke, air-powered retract stroke) is now available as well as single acting air-powered advance, spring return units. Previously available in 1-in. stroke only, both types are now offered in 1, 2, 3, and 4-in. strokes.

The compactness and mounting flexibility of the cylinder make it well suited for all types of clamping, parts positioning and ejecting, as well as light-duty tool and work feeding operations, the company says.

The cylinders are equipped for simple, universal mounting; they may be front- or side-mounted, front or rear flange-mounted, or front pivot-mounted. The $^{5}/_{16}$-in. piston rod is threaded for easy coupling to work loads. All models develop a thrust equal to the air pressure applied.


# DIMENSIONS ONLY TELL HALF THE STORY...

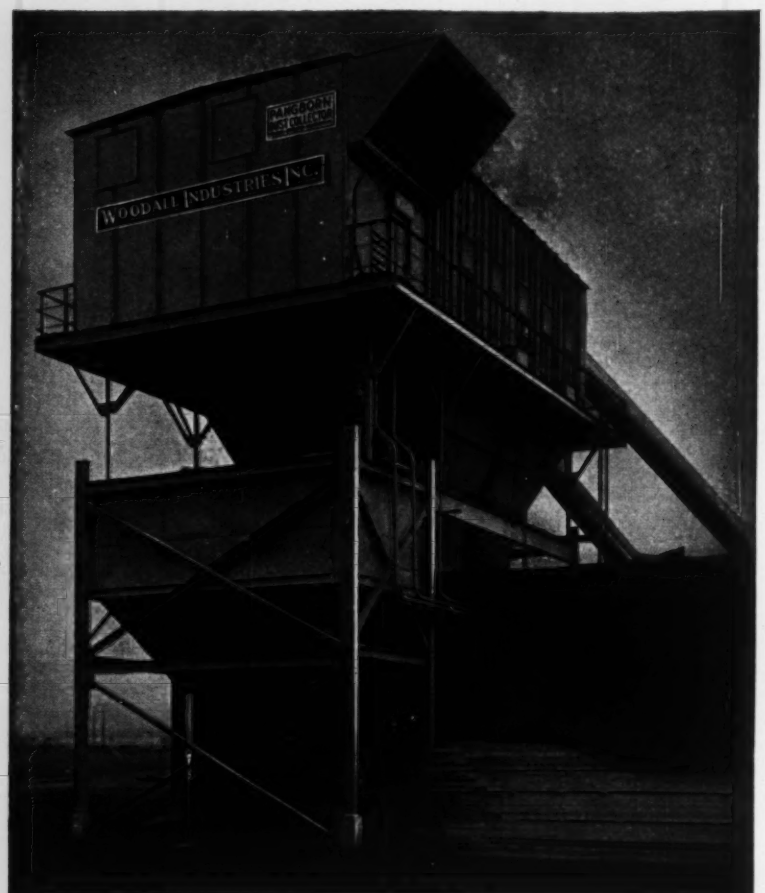
. . . about worm gear speed reducers. You've got to compare size with load capacity for the whole picture. Inside a Cone-Drive speed reducer you'll find the double-enveloping worm gear design that makes it the most efficient right-angle speed reducer available.

Take the standard 3" center distance unit above for example. Here are its Class I Service Ratings with a 5:1 reduction:

| Worm RPM | 100 | 200 | 300 | 580 | 720 | 870 | 1150 | 1750 |
|---|---|---|---|---|---|---|---|---|
| Mech. HP | 1.24 | 2.21 | 3.08 | 4.89 | 5.61 | 6.34 | 7.41 | 9.04 |
| Thermal HP | 1.24 | 2.21 | 3.08 | 4.20 | 4.62 | 5.10 | 6.00 | 7.80 |
| Output Torque (inch-lbs.) | 3340 | 3010 | 2830 | 2405 | 2250 | 2150 | 1940 | 1575 |

That's a lot of capacity for a unit that occupies less floor space than this magazine page. But it's typical of Cone-Drive speed reducers and gearsets. Complete details on this model in Bulletin 600-C. Other units to 800 HP and ratios to 4900:1.

CONE-DRIVE GEARS
Division Michigan Tool Company
DOUBLE ENVELOPING GEAR SETS & SPEED REDUCERS
7171 E. McNichols Road • Detroit 12, Michigan




**Pangborn Dust Control**

**Saves $14,000 a year**

***for Woodall***

**The Long Island plant of Woodall Industries, Inc., had a serious problem. Fabricating Masonite for its hundreds of products released so much dust that, without efficient dust control, work would be practically impossible. So Woodall installed a Pangborn Dust Control system.**

**The result? The dust collected not only leaves the plant dust-free but provides *all* the fuel for heating and processing requirements. Savings on fuel bills amount to $14,000 a year! Pangborn Dust Control at Woodall pays its own way *with a profit* for the firm.**

**Pangborn can solve *your* dust problem. Pangborn engineers will be glad to show you how Pangborn Wet or Dry Dust Collectors can save you time, trouble and money!**

**See how Pangborn benefits varied industries. Write for free copy of "Out of the Realm of Dust." Pangborn Corp., 2200 Pangborn Blvd., Hagerstown, Md. *Manufacturers of Dust Control and Blast Cleaning Equipment.***

**Pangborn**

**CONTROLS DUST**

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## Resin Coating

Glidden Co., Cleveland, Ohio, has introduced a 100 per cent solids resin coating, named Glid-Iron, which it says provides a labor-saving, low-cost solution to maintaining and upgrading wood, metal, and masonry surfaces in plant facilities.

The company says the coating has excellent adhesion to wood, metal, and concrete, and is highly resistant to chemicals. It is said to be ideal as a floor coating in fruit processing plants, canneries, dairies, plating and chemical plants, and machine shop areas where the spillage of chemicals and oils is common.

Glidden officials said current tests show that an interior application of Glid-Iron protects concrete silos from the destructive and corrosive effect of silage.

Application costs of the material are set at 15 to 19 cents per sq ft. Other methods range up to 35 cents per sq ft, the company says.

The coating may be applied by spray, brush, roller or squeegee in any mil thickness, $^1/_{16}$ to $^1/_2$ in. is desired. Application time for a 10 × 40 ft area is 20 to 30 minutes with an undercoating gun, and two to four man hours by other application methods.

The company says the new coating sets to a hard, tough, flexible and scuff resistant finish after curing overnight at normal room temperatures. It is said to have outstanding resistance to shock and impact, showing no adverse effects from the extremely heavy weights and rough abuse caused by materials handling lift trucks and other such mechanized equipment.

Glidden research technicians report Glid-Iron will withstand temperatures from minus 20 to plus 212 F. The floor coating is skid-proof even when wet with rain or snow and nails may be driven through the film without it chipping, they add. The coating may be supplied in any color.

## Thermocouple Meters

A new series of thermocouple meters is now available from the Greibach Instruments Corp., Metuchen, N. J., an associate of Gulton Industries, Inc.

These meters, which are able to withstand a very high overload and require only 25 per cent of the energy input of conventional meters, utilize a new bifilar or twin-wire suspension of the moving coil. Employing a unique tensioning design whereby the bifilar wires always return to zero position with no current flow, the meters cannot be damaged by external vibrations, the company states. Frictional losses are eliminated.

High sensitivity of up to 1000 ohms per volt normally enables these meters to measure frequencies up to 10kc with an accuracy of 0.5 per cent at 25 C. The new thermocouple series of instruments is produced in voltmeter models down to 300 mv full scale and ammeter models down to 1 ma full scale (single range) and 2 ma full scale (multirange).

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NEW EQUIPMENT
BUSINESS NOTES
LATEST CATALOGS

## Brazing Alloy

A new nickel-base brazing alloy which features unusually low brazing temperature, excellent flow and wetting properties, thin to moderate fillet formation and no erosion during brazing is now available from Wall Colmonoy Corporation, 19345 John R. Street, Detroit 3, Michigan.

The new nickel-phosphorous material, called Nicrobraz No. 10, is recommended for low temperature joining of stainless steels, nickel-base alloys and cobalt base alloys, as well as low alloy steels, carbon steels, copper and other base metals having a melting point above 1900° F, in applications involving service temperatures from 60° F to 1500° F.

## Sonic Energy Cleaner

A patented emulsion cleaner for the removal of oily soil and greases has been introduced by Kelite Corp., 1250 N. Main St., Los Angeles 12, Calif. The cleaner called Ke-sonic, is used for routine cleaning of aircraft, ship bunkers, trucks, automotive, railroad equipment, and heavy machinery. The company says the material is exceptionally desirable for marine use because removal soil is held in stabilized emulsion even when mixed with sea water.

One form, Ke-sonic-C is employed by diluting with kerosene, diesel fuel or No. 2 fuel oil, and the soiled parts then sprayed, brushed, wiped, or immersed in the solution. The company says it is corrosion safe on all structural metals, and is unique among emulsion cleaners in that it will clean metal to provide a no-water break rinse.

Ke-sonic may be diluted with up to 20 parts of water and used in industrial pressure washing machines for the removal of oily soil from metal parts. Both materials are said to be fire safe, and exhibit a Cleveland open cup flash point of 180 F and a Cleveland open cup fire point of 220 F.

## Fractional Slip Ring Motors

Variable speed and step-by-step starting features of slip ring motors are now available as standard units in fractional ratings of 1/4, 1/3, 1/2 and 3/4 hp, it is announced by Reuland Electric Co., Alhambra, Calif. The units are in the small No. 66 frame size which represents an approximately 2-in. reduction in both length and diameter from the previously smallest size, the company says.

The motors are designed for use on printing presses, conveyors, ventilating equipment, cranes and hoists, and other machines that require operator-regulated running speeds. An example of the motor's versatility is the starting of a heavy load on regular low line current, the company says. High starting torque is provided by starting in a slow-speed "step"; full speed is attained through a series of steps. The motors are available with speed selections from 50 to 100 per cent of full load speeds in 1800 and 1200 rpm.

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## Stainless Steel Pumps

Vanton Pump & Equipment Corp., Hillside, N. J., announces a new line of "Flex-Alloy" stainless steel rotary pumps for corrosive solutions, abrasive slurries and fluids which must be maintained free from contamination.

The company says the pumps, available in either type 304 or 316 alloy (special alloys available on request), incorporate the flexi-liner principle of operation, which eliminates entirely the need for stuffing boxes or shaft seals of any sort. The fluid is progressively squeegeed in a passage formed by the inner surface of a flexible, natural, synthetic rubber or plastic liner. The use of a stainless steel pump housing along with a Hypalon liner allows for handling solutions at temperatures up to 265 F. The gentle pumping action of the pump enables it to handle shear sensitive emulsions and suspensions, the company says.

The pumps are self-priming and avoid the use of gaskets or check valves. Pump units are available in capacity ratings from 1/8 to 20 gpm and can be furnished either direct connected to constant speed or variable speed motor equipment. When utilized with variable speed drives, variable flow rates can be obtained. Vacuums up to 26 in. of mercury are developed on the suction side of the pump.

## Spring-Acting Fastener

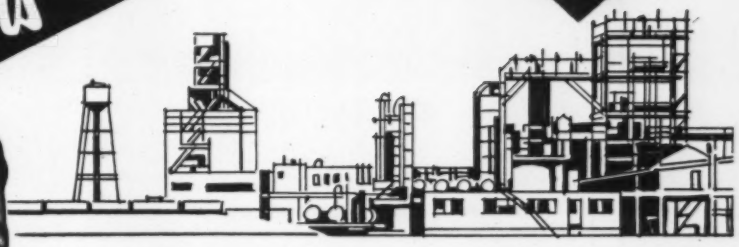
A spring-loaded model has been added to the line of positive-locking link-lock fasteners offered by the Simmons Fastener Corp., 1700 N. Broadway, Albany, N. Y. The company says the new unit provides greater mounting flexibility and automatic take-up, where desired.

The spring action provides take-up to compensate for permanent set in gasketing, irregularities of sealing surfaces and mounting inaccuracies. Spring action is only effective up to 75 per cent of the fastener's maximum loading. When heavily loaded, the loads are carried by rigid members. This eliminates the possibility of spring failure under maximum loading, the company states.

Spring-acting link-lock is said to be ideally adapted to wooden boxes and other inexpensive containers where costs will not permit precision production. Available on either the No. 2 (medium-duty) or No. 3 (light-duty) link-lock, the spring-acting model retains the features designed to make it applicable wherever pressure-tight sealing is required, the company says. The unit is said to have good impact and drop-test resistance, and will work well in Arctic temperatures. Locked fastener is flat against the side of case. Drop wing locks in down position. Engagement latch detail can be varied to meet different design conditions. A 180-deg turn opens or closes lock. Link-lock No. 2 will safely carry up to 1000-lb tension loading, while No. 3 will carry up to 300-lb tension, the firm states.

*Continued on Page 50*

# Memo to: Successful Engineers



Chemstrand today seeks *successful engineers* capable of growing with this rapidly-expanding company which is already a leader in the dynamic, fast-growing synthetic fibers field.

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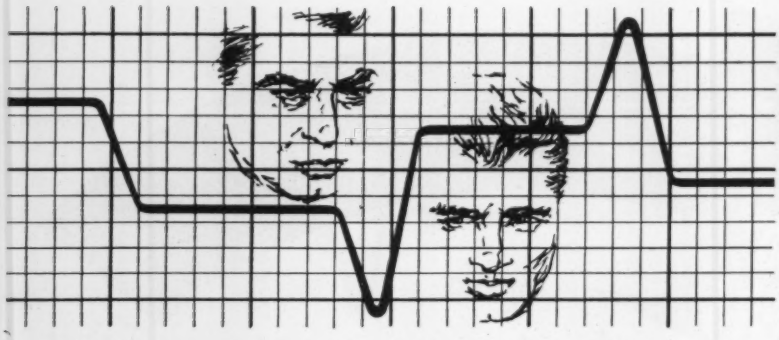

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Professionally and personally, engineers and scientists look to the future. They seek lasting, satisfying careers . . . not "jobs" that merely meet the needs of the moment. And this search inevitably poses the question: "What makes a desirable career?" For the man of real ability, this question becomes largely a choice of opportunities. He is the man we need and want . . . here is what we offer in return.

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## Pipeline Valve

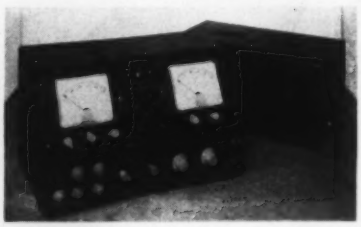
Robertshaw-Fulton Controls Co., Box 400 Knoxville, Tenn., is introducing its new type "MA" valve said to be particularly applicable on medium and high pressure pipelines for difficult dead-end or complete shut-off service.

It was specially designed, the announcement said to avoid sticking and clogging. At the same time, the valve does not develop a tendency to "chatter or rattle." In tests on pipelines with pressures up to 250 psi the valve has functioned quietly, the company said.

It is available in sizes from $^3/_4$ to 2 in. inclusive. The valve body is cast bronze. Poppet, seat insert, pilot poppet and pilot seat are fabricated from stainless steel, and the valve stem is of Monel. Sizes $^3/_4$ to $1^1/_2$ in. have union ends; 2 in. size, flanged ends.

The valve, which is piston balanced, contains a poppet that is directly operated by the valve stem, and is considered full modulating. The company said maintenance of the new valve is simplified by readily available factory-finished replacement assemblies.

Prices of the new valves, the company said, are in line with its series "F" valves.



## Transistor Test Set

Both high and low-power transistors, either point-contact or junction types with collector dissipation as high as 50 w, can be tested in either common-emitter or the common-base connection with a transistor test set. Model T-62, introduced by Scientific Specialties Corp., Snow & Union Sts., Boston, Mass.

The test set features the direct reading of small signal parameters ($h_{11}$, $h_{12}$, $h_{22}$, alpha and beta) as well as of the static characteristics $I_{co}$, $V_b$, $V_e$, $V_c$, $I_b$, $I_e$, and $I_c$. All ranges of practical interest are provided at very low test signal levels.

The self-contained oscillator and locked-in phase-sensitive voltmeter, whose amplifier is highly degenerative at frequencies other than the oscillator frequency, results in a highly selective measuring circuit capable of a high degree of accuracy and reproductibility, according to the company.

Five current-bias ranges from 50 ma to 500 ma full scale, and two collector voltage-bias ranges of from 0 to 10 v and from 0 to 100 v are provided. All power supplies are self-contained. No batteries are used.

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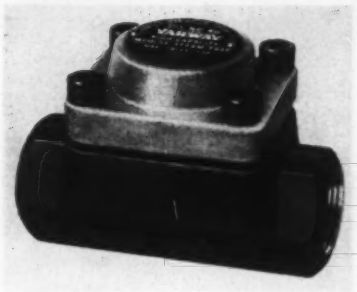
NEW EQUIPMENT
BUSINESS NOTES
LATEST CATALOGS



## Impulse Steam Trap

Yarnall-Waring Co., Philadelphia 18, Pa. has added to its line of impulse steam traps a new No. 40 Series, specially designed with high capacity to handle heavy condensate loads.

Capacities are approximately two to three times that of the same size standard No. 60 Series impulse steam traps produced by the company. The firm says outstanding features of the new trap include high capacity at all pressures up to 600 lb, complete stainless steel body and internal parts, excellent low pressure operation (no orifice change or adjustment is required 0 to 600 lb), steam temperature condensate discharge characteristics, freeze-proof operation against back pressure up to 50 per cent.

Typical applications of the new series are on unit heaters, heating coils, storage water heaters, kettles, large fuel oil preheaters, dryers, evaporators, large platens, autoclaves, heat exchangers, the company says. The traps are now available in $^1/_2$ and $^3/_4$-in. sizes. Larger sizes will soon be available.

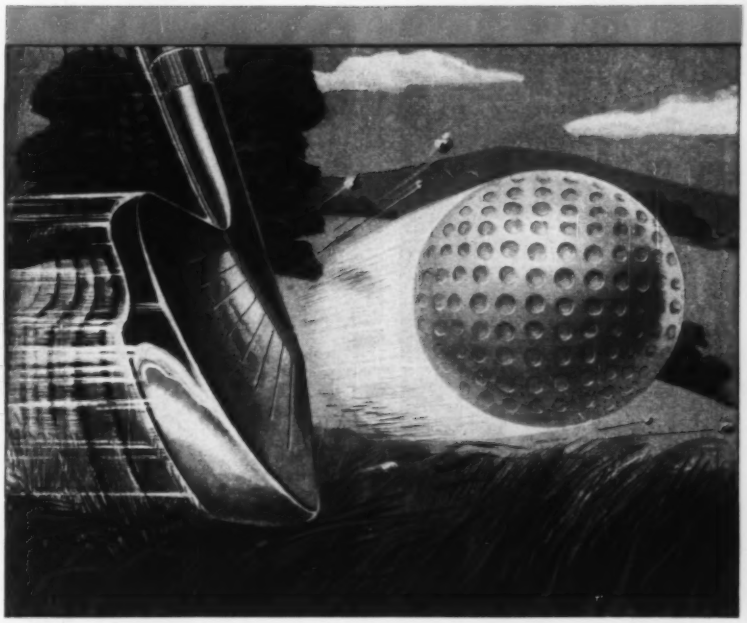
## High Heat Paint

A new low cost black high heat paint that is reputed to offer maximum protection for surfaces subjected to temperatures up to 750 F is announced by Speco, Inc., 7308 Associate Ave., Cleveland 9, Ohio.

Known as HSE (hot surface elastic) black, it is composed of a black pitch base bolstered with a special silicone additive. This combination is said to form a heavy-bodied coating that does not blister or become brittle when when subjected to varied temperatures, smoke, fumes, mild industrial acids, alkalis and moisture.

According to the manufacturer, HSE air dries to a smooth finish in 8 to 10 hours and does not require special baking to be completely effective. As a result, it can be used as needed on all applications without interrupting regular schedules.

Recommended uses for HSE include the protection of heat lines, radiators, condensors, compressors, turbines, boilers, stacks, tanks, ovens, furnaces, steam lines, vats, separators and exhaust manifolds. Applied by brush or spray, it is available in quart or gallon cans, 5-gallon pails, 30 and 55-gallon drums.

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forgings withstand repeated shock safely

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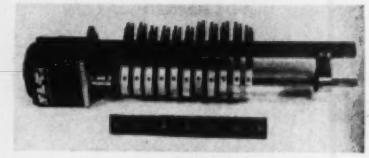

## Motor-Driven Interrupter

Now available for use in automation and related work is the type BC motor driven interrupter, a standard item in telephone exchanges for many years, manufactured by National Pneumatic Co., Inc., Holtzer-Cabot Div., 125 Amory St., Boston 19, Mass.

Two units are available, one containing from one to six circuits and the other containing from seven to sixteen circuits. The drive motor is the firm's 25 size with internal gear reducer, totally enclosed. The standard 115 v, 60 cycle unit consumes 10 w. Windings for other voltages and frequencies are available. Sealed ball bearings are used. Many output shaft speeds are available, including 1, 2, 6, 7, 5, 10, 15 rpm.

The cam shaft is made of stainless steel. Machined nylon cams are used. Guaranteed accuracy for any point on any one cam is ±1.5 deg. Guaranteed accuracy between points on any two cams is ±2.25 deg. Cams are keyed to the shaft. Seven types of telephone-style spring pile-ups are available.

Nylon pile-up followers are used for nylon-to-nylon contact with the cams. The ends of the spring of the pile-ups to which external connections are made are tinned for $^{7}/_{16}$ in. Contacts are a platinum-iridium alloy. Contact rating for 115 v ac is 2 amp, resistive load.

## Small Reactors

Several new construction features are available on small glass lined reactors offered by the Pfaudler Co., 1000 West Ave., Rochester, N. Y. First, the Company's new P series reactors can have a pressure lubricator for seals; or they can be constructed for high-pressure work with standardized parts.

The high-pressure units are rated at 150 psi. In addition, the firm's new hydraulic or air motor drive is available for use on these reactors.

Type P reactors, which range from 5 to 100 gal in capacity, fulfill operational requirements of high pressure and temperature reactions, the firm states. In such cases, it is usually desirable to maintain seal chamber liquid at 25 psi above the reactor pressure and at a temperature below 250 F.

Standard low-pressure reactors in this series are rated for 25 or 30 psi internal pressure. A high-pressure 150 psi rating is obtained by using a thicker cover with heavier nozzles, reinforcing the vessel body and by using more and heavier cover clamps.

The company's PW drive has a full-throated worm gear shaped to increase tooth contact area, resulting in high load capacity. When used in conjunction with a PW drive, the new hydraulic or air motor has a varied

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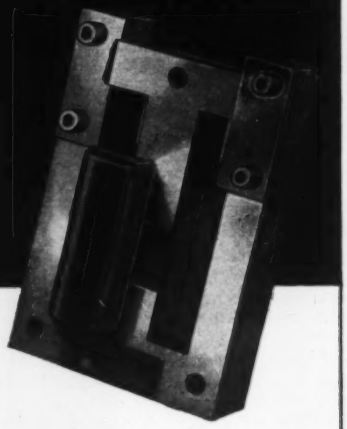

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1. ***Made in Push and Pull types—within sizes ranging from 2½ to 21 lbs. at ½-inch stroke—to 2 to 25 lbs. at 1-inch stroke.***
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3. ***Compact—especially suited for limited space service.***
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speed from 20 to 300 rpm. The hydraulic drive is explosion proof.

The basic hydraulic drive has an adjustable agitator speed range from 100 to 1500 rpm, without the PW drive. Hydraulic drive, the company says, eliminates belts, belt guards, motor supports and gear reducers in most applications.

P series reactors are efficient for use in laboratories, pilot plants or small scale manufacturing, the company says. The basic design is similar to larger vessels, so parallel results may be anticipated in working from laboratory to pilot plant and then going on stream with full scale production.

## Hydraulic Valves

Addition of $^3/_8$- and $^1/_2$-in. ips 3- and 4-way air, water, and low-pressure hydraulic valves to the firm's directional control valve series has been announced by Rotex Punch Co., Inc., 2350 Alvarado, San Leandro, Calif.

The company also has announced the development of a 4-part-4-way valve in its $^1/_4$, $^3/_8$, and $^1/_2$ in. sizes. All models are available except double end controls, such as double solenoid pilot or cam. The two new additions are constructed similarly to the company's $^1/_4$-in. valve and feature chamfered air passage ports, bronze cast body, bronze sleeve, aluminum spool and interchangeable, corrosion proof operating attachments.

More than 100 combinations of actuators are available, with an added jogging action in solenoid operation controlled by a manual pressure button to actuate spool.

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NEW EQUIPMENT
BUSINESS NOTES
LATEST CATALOGS

## Machine Tape Minder

A new universal model "Tape Minder" to supplement the firm's standard model is announced by Cycle Equipment Co., 420 Market St., San Francisco, Calif.

The company says the new model will find application for such tape-producing equipment as those used for teletype, ticker, automatic typewriter, accounting, and computer applications.

The new model features greater flexibility of use, the company says. Three sizes of winding reels are available and are interchangeable on the basic machine, making the machine useful changing requirements. Reels are quick-threading, instantly removed or replaced, and available with either large cores for re-transmitting or small cores for filing.

An exclusive operating arm coupled to a long-interval on-off switch provides delayed-action winding which operates the fan-cooled motor only one-sixth of the total operating time, the company points out. This same operating arm is built integral to a clutch release mechanism which permits an operator to spin the reels for back reference. A spring-latch is also built into the clutch release to make it possible to fix the arm in a down position to free both hands for tape inspection.

Other features include positive mechanical drive controlled by a clutch-release, reversible tape-retainer guides permitting flexibility in direction of feed, adjustable guide-arm to accommodate difficult positioning, and ball-bearing shaft mountings for long life.

Tape can be fed to the machine from above or below, right or left side, from front or back, underneath or even at right angles to the reel.

## Air Regulator

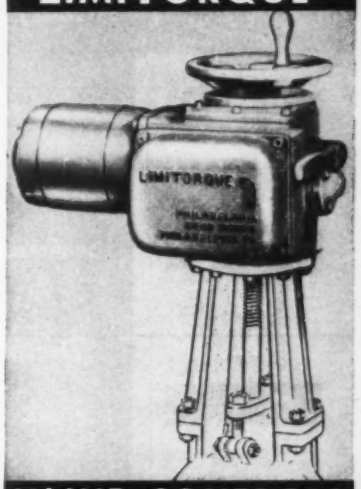
Black, Sivalls & Bryson, Inc., 7500 E. 12th St., Kansas City 26, Mo., introduces a new instrument air regulator, Type 73–26, designed to provide the close regulation demanded for instrument air supply in pneumatic instrumentation and in other installations requiring extreme sensitivity of pressure output in small volumes of air or other gas.

The unit features a 40 micron phenolic impregnated cellulose filter. It has a minimum pressure drift from set point, gives instantaneous response to changes in flow rate. It provides easy adjustment to within close limits for any pressure within its output range, the company says.

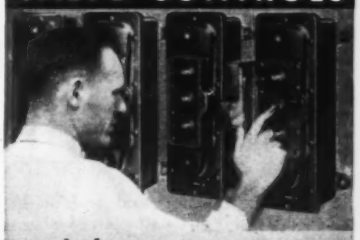
The new regulator can be panel or bracket mounted and serviced without removing from air line. It is available with or without auxiliary pressure gage.

Connections are $^1/_4$-in. pipe. Maximum input pressure is 300 psig. Maximum output pressure is 40 psig; 100 psig with special spring. Body is of die cast aluminum alloy with stainless and plated steel internals to provide a study but light weight regulator.

LIMITORQUE




VALVE CONTROLS



push-button operation

Here's a completely automatic, dependable, low cost valve operator for small valves. Size-for-size, the types SMA-00 and SMA-000 Limitorque Valve Operators are designed for greater valve stem capacity; will produce more stem torque, and withstand greater thrust than any other operator on the market. They are readily adaptable to all types of valves—gate, plug, globe and butterfly; and they have many of the exclusive features which have made the larger Limitorque Operators the most widely used in the world.

Send for Catalog L-550 and see why this and other types of Limitorque Valve Operators are so widely used.

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Established 1892

Engineering News from Bridgeport Thermostat

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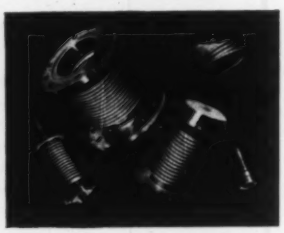
# MINIATURE BELLOWS FOR INSTRUMENTS and AIRCRAFT

Save space and weight in instrument and aircraft design. Specify small-diameter seamless metal bellows. Bridgeport Thermostat's specialized experience in bellows engineering provides these tiny units as small as ¼" and 5/16" diameter, and in a wide range of characteristics and metals.



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Practical savings in time, trouble and money can be made by buying complete bellows assemblies . . . let Bridgeport Thermostat show you how.

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☐ Full details on new, small-diameter bellows

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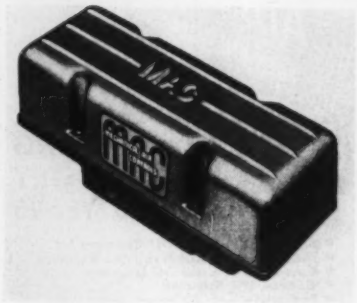

## Solenoid Air Valve

A new three-position, four-way double solenoid air valve has been introduced by Mechanical Air Controls, Inc., 10030 Capital, Oak Park, Detroit 37, Mich. According to the company, the valve features a neutral position and is available with either open or closed centers.

The firm points out that on the open center (Model 1013) both cylinder ports are open to exhaust and pressure is blocked when solenoids are de-energized, leaving the cylinder rod in a free state. When energized, one port opens to line pressure, the other remains open to exhaust.

The ports of the closed center (Model No. 1023) are blocked from pressure and exhaust when solenoids are de-energized, holding the rod in a locked position. When energized, one port opens to pressure, the other to exhaust. Both models are currently available in ⅜ in. ips. Side porting is standard, bottom ports are available upon request.

## Dial Thermometer

A new bimetallic dial thermometer for a wide variety of applications is announced by Taylor Instrument Co., 95 Ames St., Rochester, N. Y. Called the Bi-Therm dial thermometer, it is offered for such industrial and institutional services as pipe lines, hot water tanks, storage tanks, ovens, air ducts, bottle washers, food cookers, sterilizers.

The company says the units are easy to read, economical in price, rugged, and accurate within plus or minus 1 per cent of range over the entire range, it is available with 3- or 5-in. dials and stem lengths of 4, 6, 9, and 12 in. Separable wells of brass, steel, type 304 stainless steel, or Monel are available. Ranges of the various instruments run from minus 40 to plus 750 F. All exposed metal parts are of arc-welded corrosion-resistant stainless steel.

Instruments are waterproof and mechanical connections are welded for greater toughness and reliability. There is no ambient temperature effect. Over-range protection is 50 per cent up to 500 F and 10 per cent above 500 F. All instruments, except for the unit having the 200 to 750 F range, are silicone-damped against vibrations.

*Continued on Page 57*

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|---|---|---|---|---|---|---|---|---|---|---|---|---|
| IFC | 14–15 | 27 | 41 | 54 | 66L | 75R | 87BL | 99 | 112 | 124 | 132BR | 165 |
| 1 | 16 | 28–29 | 42 | 57 | 67L | 77 | 87BR | 101 | 113 | 125 | 133 | 167 |
| 2 | 17 | 30 | 44 | 58 | 67R | 78 | 88 | 102 | 115 | 126 | 134TL | 169 |
| 3 | 18–19 | 31 | 45 | 59 | 68 | 79 | 89–90 | 103 | 116 | 127 | 134R | 170 |
| 4–5 | 20 | 32 | 46 | 60T | 69 | 80T | 91 | 104 | 117 | 128 | 135 | IBC |
| 6–7 | 21 | 33 | 47 | 60BL | 70T | 81 | 93 | 105 | 118 | 129 | 136TL | OBC |
| 8–9 | 22 | 34 | 48 | 60BR | 71 | 83 | 94 | 107 | 119 | 130TL | 136BL | |
| 10 | 23 | 35 | 51 | 61T | 72–73 | 85BL | 95 | 108 | 120 | 130B | 139 | |
| 11 | 24 | 36 | 52 | 61B | 74L | 85BR | 96 | 109 | 121 | 131 | 141 | |
| 12 | 25 | 37 | 53TL | 63 | 74R | 86BL | 97 | 110 | 122 | 132L | 142 | |
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**MECHANICAL ENGINEERING** — February 1956 issue

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| IFC | 14–15 | 27 | 41 | 54 | 66L | 75R | 87BL | 99 | 112 | 124 | 132BR | 165 |
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| 3 | 18–19 | 31 | 45 | 59 | 68 | 79 | 89–90 | 103 | 116 | 127 | 134R | 170 |
| 4–5 | 20 | 32 | 46 | 60T | 69 | 80T | 91 | 104 | 117 | 128 | 135 | IBC |
| 6–7 | 21 | 33 | 47 | 60BL | 70T | 81 | 93 | 105 | 118 | 129 | 136TL | OBC |
| 8–9 | 22 | 34 | 48 | 60BR | 71 | 83 | 94 | 107 | 119 | 130TL | 136BL | |
| 10 | 23 | 35 | 51 | 61T | 72–73 | 85BL | 95 | 108 | 120 | 130B | 139 | |
| 11 | 24 | 36 | 52 | 61B | 74L | 85BR | 96 | 109 | 121 | 131 | 141 | |
| 12 | 25 | 37 | 53TL | 63 | 74R | 86BL | 97 | 110 | 122 | 132L | 142 | |
| 13 | 26 | 39 | 53R | 65 | 75L | 86BR | 98 | 111 | 123 | 132TR | 164BL | |

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# KEEP INFORMED

NEW EQUIPMENT | BUSINESS NOTES | LATEST CATALOGS

## Pressure Reducing Valve

A new direct-operated water pressure reducing valve has been introduced by Spence Engineering Co., Inc., Walden, N. Y. Called the D25, the new valve is said to be able to regulate water flow to such fast-acting equipment as flushometers and snap cocks. It incorporates a high pressure molded diaphragm and heavy spring chamber construction for operation in the reduced pressure range between 30 and 80 psi.

It is especially designed for dead-end water service where flow is intermittent and subject to abrupt fluctuations. Design features include an essentially balanced single seat to minimize variation in delivery pressure resulting from varying inlet pressure; large paranite diaphragm for sensitive response; packless construction eliminates stuffing box friction; composition single seat provides for dead-end shutoff and prevents pressure-creep when no flow is required.

It is recommended by the company for industrial processing operations; municipal or plant water mains; apartment houses, hotels, office buildings and hospitals to provide each floor with steady pressure.

## All-Purpose Hose

A new, advanced type of all-purpose hose has been announced by Manhattan Rubber Div., Raybestos-Manhattan, Inc., Passaic, N. J. Described as suitable for use with air, oil, water, and mild chemicals, the new hose is being marketed under the trade name of Allflex.

The company says the new hose has extremely long life and is non-kinking. It is the first all-purpose hose of mandrel-made, horizontal braided construction produced by the company.

## Automatic-Drain Filter

New and larger sizes have been added to its line of air line filters with automatic-draining facilities to meet the demand of plants with $^3/_4$ and 1-in. compressed air lines, the C. A. Norgren Co., Englewood, Col., has announced.

Models 11,200-6 and 11,200-8 are completely automatic. They are designed to create a strong centrifugal force to remove a high percentage of moisture from the air stream. Both models are available with a choice of three types of filter elements for the removal of solids standard 200-mesh wire screen (74 micron) and two optional 64- and 25- micron sintered bronze elements.

A float-actuated drain mechanism discharges collected moisture automatically under constant or fluctuating air pressure and with or without air flowing. Special protection is provided to prevent entry of solids into the drain mechanism. The water capacity of approximately $1^1/_4$ pints (which controls draining frequency) keeps wear on the drain mechanism at a minimum, the company says.

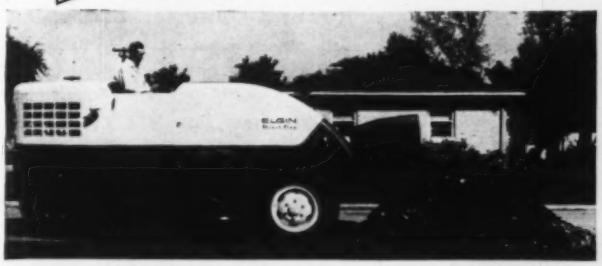
## Sub-Miniature Gyroscope

A new series of precision sub-miniature rate gyroscopes, 1 in. in diam, $2^1/_8$ in. long and weighing only 4 oz has been introduced by Robey Rotor Div., J. B. Rea Co., 1723 Cloverfield Blvd., Santa Monica, Calif.

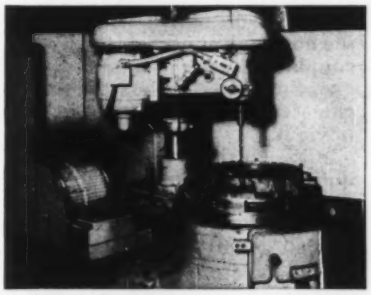
Accurate and rugged spring restrained, these gyros offer application possibilities for all types of controls, the compay says. They are hermetically sealed and designed to withstand extremes of shock, vibration and temperature fluctuation. Rate range is from 10 to 500 deg per sec. Natural frequency is 8 to 75 cps (undamped), depending on rate range. Precision potentiometers pick-offs for d-c, or inductance pick-offs such as variable transformers or syncros for a c, are included. The company says the pick-offs are tailored to meet the application of each gyroscope. Motor excitation is supplied with 400 cycle hysteresis synchronous motors for 6, 12, or 26 v, one, two, or three phase operation.


ROCKFORD

MEMO— Clutch must have accurate balance



All ROCKFORD clutch plates not only are carefully checked for accuracy of dimensions, but are inspected on an electronic balancing machine. Uniform operation, minimum wear,



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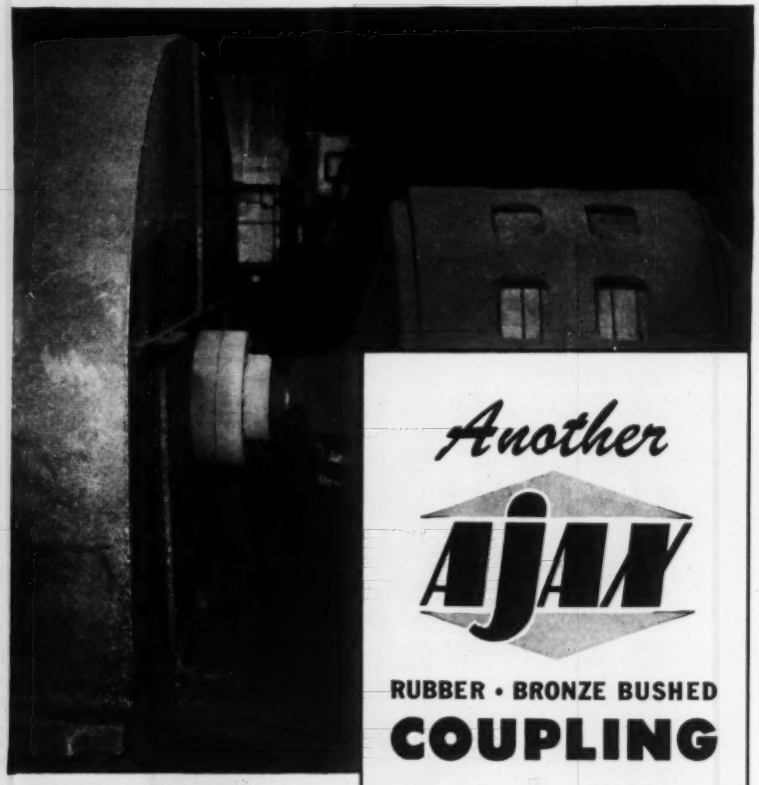
less frequent adjustment and long life qualities of ROCKFORD CLUTCHES thus are protected during production.

Let our engineers show you how ROCKFORD quality safeguards insure low maintenance for ROCKFORD clutch equipped machines.

ROCKFORD
Clutch Division
BORG-WARNER
1307 Eighteenth Ave., Rockford, Ill.

CLUTCHES



Another

AJAX

RUBBER • BRONZE BUSHED

COUPLING

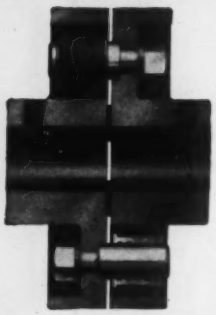
***Running for 30 Years Without One Cent for Maintenance (Nobody Even Wiped the Dirt off)***

This Ajax Rubber-Bronze Bushed Coupling has been operating continuously in heavy duty steel mill service without attention for years and years and years.

When you remember that all the horsepower goes through the coupling, the importance of safeguarding direct-connected machines against misalignment is obvious.

Ajax Flexible Couplings are quiet running and require no lubrication. There is no objectionable backlash. Elimination of shut-downs of machines and entire departments is far more important than their low first cost.

Ajax engineers have specialized on flexible couplings for 35 years. It will pay you to put your drive problems up to Ajax.



**HOW THEY WORK**

● Since it is impossible to mount two shafts, each in its own bearings so that they will rotate around the same axis, it is imperative that the couplings which surround these shafts permit each shaft to rotate around its own axis without creating vibration, backlash, strain or wear, reversal of torque, and all other detrimental factors that enter into direct connection of power. Misalignment between shafts of driving and driven machines is a serious overload factor contributing to rapid bearing wear. This is intensified by today's demand for high operating standards, increased loads, and space limitations.

**AJAX FLEXIBLE COUPLING CO. INC.**

**Westfield, N. Y.**

***Representatives in Principal Cities***


KEEP INFORMED — NEW EQUIPMENT, BUSINESS NOTES, LATEST CATALOGS

## Palletless Handling

A combination fork truck attachment for palletless handling of equipment in crates or in drum-type fiber cartons, has been developed by Baker-Raulang Co., Cleveland 2, Ohio.

The device combines the firm's finger lift device with a special addition for handling the fiber cartons in which many types of appliances are now being packaged.

The finger lift attachment mounts 40 spring-loaded fingers across its top. As the attachment contacts a crate, the fingers which encounter crate members are pushed back against their springs, out of the way. Those which find no obstruction enter the crate. When the attachment is lifted, these engage horizontal crate members, and the crate is thus lifted.

The new addition to the attachment includes two vertical swiveled plates, called carton lip plates, mounted above the fingers. These are used to pick up the type of container known as cap-and-tube, or drum-type. In this type of container approximately 4 in. of the container wall is folded outward at the top, and the carton top, or cap, fits down over the fold, forming the carton lip.

Steel strapping is run around the cap to hold it in place. The plates of the new attachment slip between the wall and the fold for lifting. They are pivoted about their centers so that two adjacent cartons being lifted at once need not have the faces in exactly the same plane. The double thickness of the fold and cap held in position by the strap is strong enough so that four cartons 2-high, side-by-side, containing refrigerators, washers, or ranges can be lifted at once, the company states.

## Centrifugal Pump Lines

Two new lines of leakless general purpose centrifugal pumps—the "Electri-Cand"—have been announced by Allis-Chalmers Mfg. Co., 4620 Forest Ave., Norwood 12, Ohio.

Designed for handling precious or hazardous liquids where no leakage is permitted,

the pumps are available in a fractional horsepower line to include motors through 2 hp, and an integral horsepower line covering motors above 2 hp. They are capable of accommodating heads to 250 ft and temperatures to 250 F and can be had with capacities to 500 gpm.

The pump utilizes the canned motor principle in which the rotor of the driving induction motor rotates in the fluid being pumped and is connected directly to the pump impeller. This construction requires no packing or mechanical seals. All rotating elements of pump and motor are contained in a thin wall cylinder or "can" making an absolutely leakproof unit.

The integral horsepower pumps have long-lived fluid piston radial bearings throughout. These are supplied with liquid through an internal connection with the pump casing discharge nozzle.

The liquid is forced through the bearing piping to the bearings, pressurizing the bearing pads. The pressure which is self-adjusting, keeps the shaft centered in the bearing.

Leakage from the bearing is collected and returned to the pump suction. Metal to metal contact only at startup virtually eliminates maintenance, the company claims.

Construction of the Type C-11B pump is similar to that of the C-11A except that the external piping is eliminated and less costly carbon sleeve radial bearings are used. There is some circulation of the liquid to wet the bearings and to flush out any solids that might get into them. Elimination of the bearing piping makes it possible to replace stators without opening the system. Carbon sleeve bearings have a shorter life than fluid piston bearings and cannot pass solids without damage.

The fractional horsepower line of pumps has only carbon sleeve radial and thrust bearings.

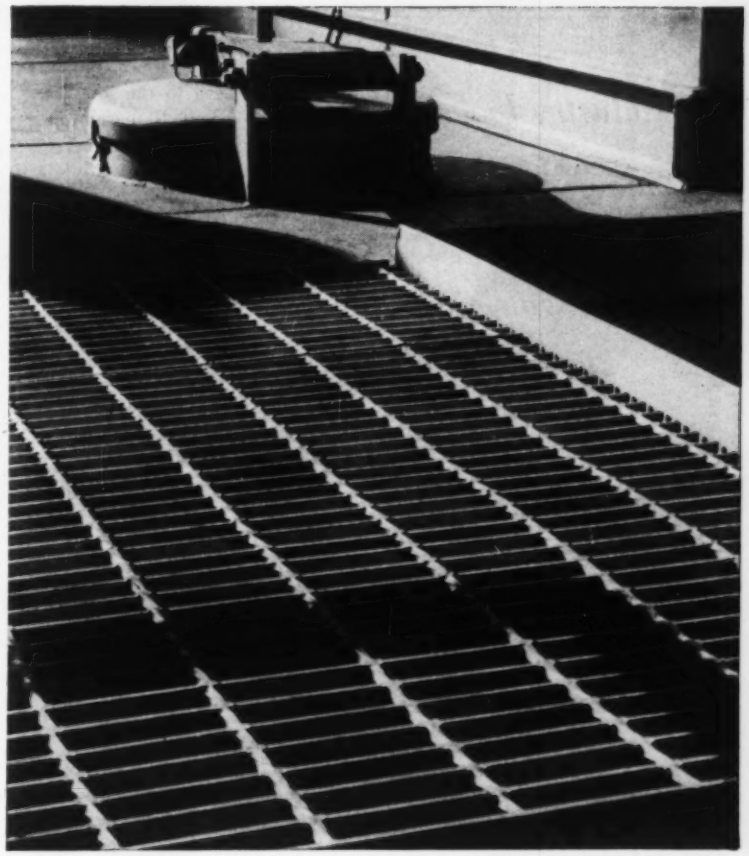
Pumps for any application permitted within the range of the two lines can be tailor-made from standard parts, permitting a flexibility of horsepower not previously available in such equipment. For any given rotor diameter, there is interchangeability of parts peculiar to the "can" feature.

## Tube Expander Control

A new tube expander drive called the Torq-Air-Matic, said to incorporate three "firsts" has been devloped by Thomas C. Wilson, Inc., Long Island City, N. Y.

The company says the unit is the first all-air driven tube expander drive, the first to offer a control entirely free from the effect of operating variables and maintenance problems, and the first to provide a cotrol with torque output calibrated in terms of ft-lb instead of arbitrary units of measurement.

The company's method of registering torque at the output spindle prevents tubes from being over-rolled or under-rolled. The readings are precise and consistent regardless of tube sheet hole variations. This control feature also eliminates overstressing of tube



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   - square bars—for smoothest walking surface
   - knurled bars (Furro-Grip)—for extra safety plus relatively smooth walking surface
   - serrated bars—for maximum safety under extremely hazardous skid conditions
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6. maximum open area—for light and ventilation

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BLAW-KNOX COMPANY
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Pittsburgh 38, Pennsylvania

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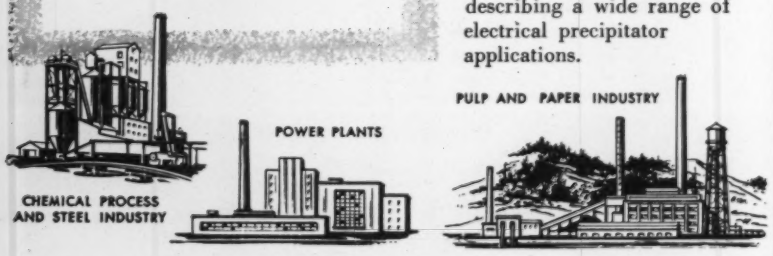


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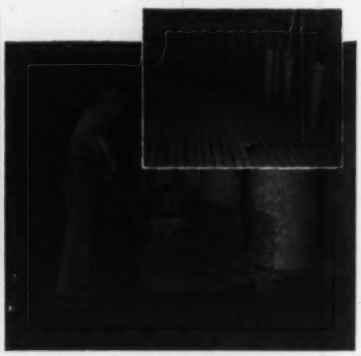

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Replace your slippery, rickety old wooden floors with the safest flooring available . . . *Tri-Lok* and *Tri-Forged* Grating. Here are some outstanding features: long life, unusual strength, adaptability, handling ease, minimum weight, maximum openings for light and ventilation. *Tri-Lok* and *Tri-Forged* products meet government specifications, are available in a wide range of panel sizes.

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Pittsburgh 22, Penna.
National Distributors


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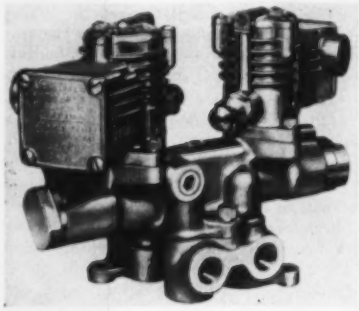
NEW EQUIPMENT
BUSINESS NOTES
LATEST CATALOGS

sheets, reduces warpage and ligament "push-over," the company says. Tube bowing is held to absolute minimum which increases the efficiency of heat exchange units.

The Torq-Air-Matic is an all-air rotating type control. It will produce 14 ft-lb torque at 90 psi with maximum consumption of 12 cfm of air. It is completely self-contained. The only connection required is the operating air hose.

The basic unit is of the pistol-grip design and is furnished with an auxiliary handle that may be swivelled to any position desired by the operator. Oil reservoir has been built into the handle. Control section is independent of the motor and lubrication is permanent. The chuck snaps on. The total weight with the auxiliary handle is approximately $7\frac{1}{2}$ lb and the length is 10 in.



### Solenoid Valve

A new double-solenoid, pilot-operated four-way valve, requiring only momentary electrical contact for operation and capable of controlling up to 600 cycles per minute, is announced by Valvair Corp., 454 Morgan Ave., Akron 11, Ohio.

It is called the double-solenoid Speed King, and is built to JIC standards. With pilot solenoids and valve fully enclosed, the unit is both moisture- and dust-proof, the company says, and the solenoid coils, completely covered with molded epoxy resin, are unaffected by oil or moisture. The valve body is a machined casting of Navy M bronze and the valve stem is hard chrome plated stainless steel.

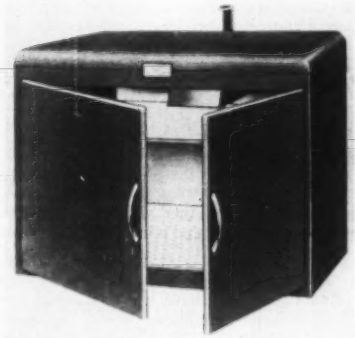
Pilot plungers and valve stem are the only moving parts. There are no springs in the main valve. According to the firm, normal service life is conservatively estimated to be in excess of 20 million cycles.

The valves are available in $\frac{1}{4}$, $\frac{3}{8}$, $\frac{1}{2}$, $\frac{3}{4}$ and 1 in. pipe sizes, with foot or sub-base type mounting. Pressure ranges in psi are 35-200 air and 35-125 hydraulic oil for both single and double solenoid valves with internal pilot supply; 0-250 air and hydraulic oil for both single and double solenoid valves with external pilot supply; 50-125 water for single and double solenoid valves with internal pilot supply; within 1 in. Hg absolute vacuum for single and double solenoid valves with external pilot supply. Pilot solenoid

coils for operation on either ac or dc and any voltage can be furnished. Maximum inrush current is approximately 10 w.

The stainless steel main valve stem floats on stationary O-ring packers to minimize wear and friction. Repacking, when necessary, can be accomplished without disturbing piping. Pilots and the sub-base mounted valve body can also be replaced without removing piping, thus reducing maintenance downtime.

Optional features include manual over-ride for use during machine setup, self-contained speed control, integral junction box with removable cover.



## Portable Electric Oven

Grieve-Hendry Co., Inc., 1401 W. Carroll Ave., Chicago 7, Ill., is introducing a portable industrial electric oven for such industrial uses, as baking enamels, lacquer, wrinkles and other finishes; dehydrating bobbins, coil forms, paper tubing; drying plastic granules and preheating sheets, parts after cleaning; preheating molds; processing; laboratory uses.

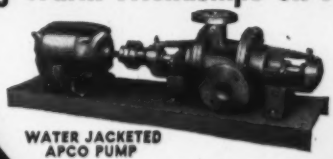
The company says the unit features uniform temperature throughout. Fresh air is drawn in and stale air driven out through specially located vents by means of a fan driven by a motor mounted on the outside of the unit. It is claimed that no stratification is possible, and that change of air and forced circulation is advantageous for any dehydration and baking process. Adjustable damper gives wide range of constant temperature.

The oven is so constructed that one will nest on top of the other. They can be used in groups and can be operated as individual ovens or selected ovens in the group can be cut out or heated at different temperatures.

Construction is heavy gage steel with asbestos air cell insulation. Model CR-1 illustrated, has single phase 100 v motor. D-c units are available.

Inside dimensions are: $28^1/_2 \times 24 \times 20^1/_2$ in. A removable shelf permits use of entire height. Price for this model capable of heating to 225 F in 15 min is $98.50. Other models for higher temperatures or models with 4 shelves, 8 drawers, or specials are available.

**Making Warm Friendships on Hot Jobs**



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Developed especially for the efficient handling of high temperature and highly volatile liquids. Delivers outstanding performance. Unbeatable on high head, small capacity duties.

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are available in many types and sizes—all noted for their streamline coordination between impellers and shells.

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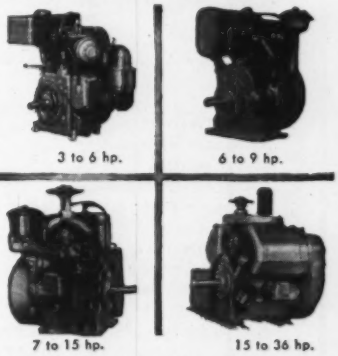
**"WISCONSIN ENGINES"**
*offer the solution to your*
**POWER PROBLEM**

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• The Wisconsin line provides the most complete power selectivity to fit both the machine and the job . . . 12 different models in 4-cycle single cylinder, 2- and 4-cylinder types in a power range from 3 to 36 hp.

Wisconsin Engineers will be glad to co-operate with you in adapting Wisconsin Air-Cooled Engines to your original equipment *most advantageously*. Tell us about your problem. "Spec" bulletins available on all Wisconsin Engines.

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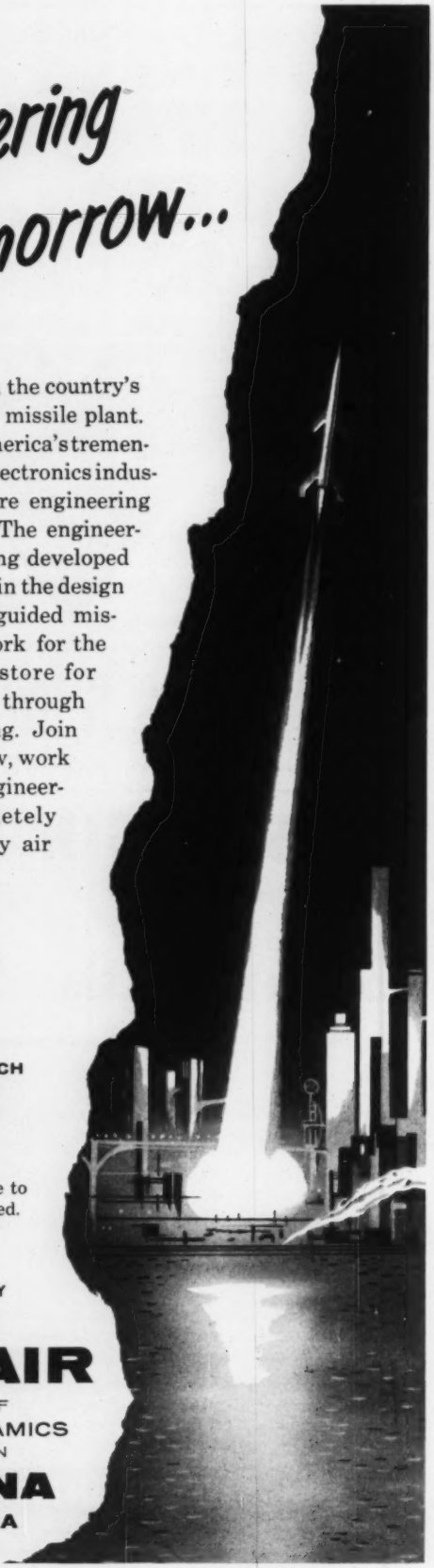


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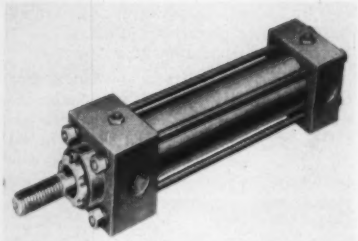

## Heavy-Duty Cylinders

Logansport Machine Co., Logansport, Ind., announces a new line of nonrotating, double acting, square-end cylinders identified as Ultra-mation cylinders. Previously, the company points out, this cylinder has been built only as special for unusually difficult high-production jobs.

The units come in five bore sizes from 2 to 6 in. and in pressures to 150 psi air to 500 psi oil. Five basic mounting styles—foot, trunnion, flange, clevis, pivot—with interchangeable covers permitting multiple mounting combinations are other features of the line. Covers, both front and blind end are of heavy steel plate.

Piston rods are extra-heavy to carry high impact loads and have highly polished surfaces to assure minimum friction and maximum packing life. Rod wipers are of synthetic rubber, and cylinder tubes are hard-drawn and corrosion-resistant for low friction. Pistons are of high-quality steel construction.

The company says the ports are adequate size, unobstructed and can be relocated to any 90-deg position by rotating cylinder covers. Tie rods are extra-heavy to resist shock loads and to maintain proper tension on cover gaskets. Cushioning is available for either or both cylinder ends as specified. Cushioned or noncushioned cylinders have same mounting dimensions.

## Segregating Valve

A slide gate type of segregating valve for pneumatic materials handling systems is announced by Allen-Sherman-Hoff Co. Designed for manual or automatic operation, the valve can be installed either in branch lines to cutoff inactive portions of the system, or at other points in the system where it is desired to isolate a portion (such as between a cyclone collector and vacuum source to permit periodic discharge to a storage bin).

Design features of the gate valve include: (1) provides tight shut off, (2) is nonclogging, (3) prevents excessive wear on gate or seat, (4) has completely enclosed, dustproof slide, and (5) has variety of operating mechanisms to suit requirements of the installation.

The valve assembly comprises two main elements, namely: the valve body and the attached operating mechanism. The body contains a slide gate of $\frac{1}{8}$-in. thick plate made from corrosion-resistant metal suitable for the material being transported. The

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BUSINESS NOTES
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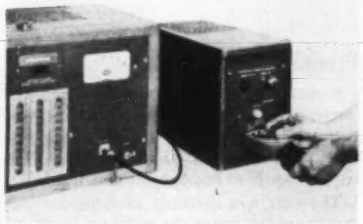
body is made of cast iron and is provided with plain ends for connection to the company's Ashcolite pipe by means of sleeve couplings. Valve sizes available are 4, 5, 6, 8, 10, and 12-in. The 8, 10, and 12-in. sizes can also be furnished with bolt flanges for for attachment to flanged steel pipe, where for example, a valve is located in the line between a cyclone collector and the source of vacuum.

Additional information is available from Allen-Sherman-Hoff Co., 259 E. Lancaster Ave., Wynnewood, Pa.



## Counter Converter

What is believed to be the first completely self-powered proportional counter converter to be available commercially has been introduced by Nuclear Measurements Corp., 2460 N. Arlington Ave., Indianapolis 18, Ind.

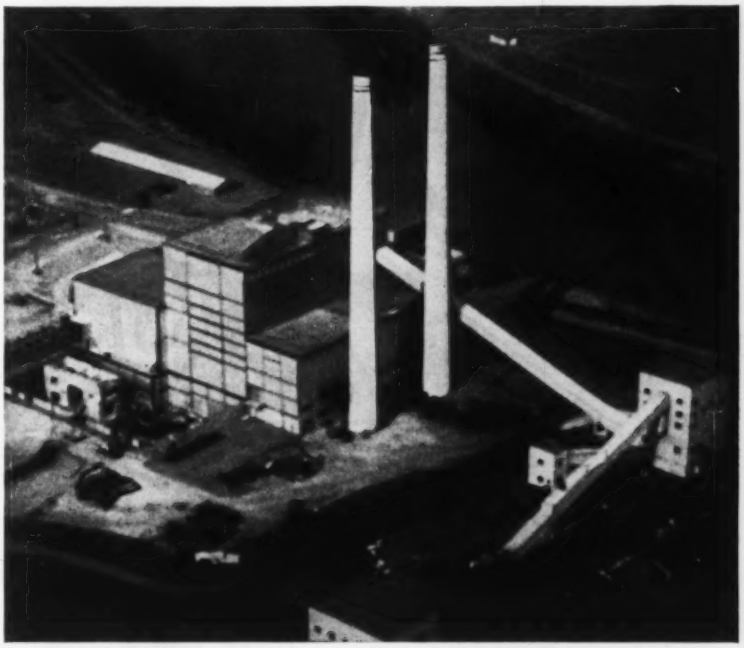
Known as Model PCC-14, the new instrument converts any scaler into a proportional counter for measuring alpha and beta activities. It has been designed for use in radiochemistry, radiobiology, radiotherapy, health physics, mineral, water and sewage assay, mineral search and nuclear physics.

The company says the unit is a highly versatile instrument, detecting alpha and beta radiation of all energies. It counts alpha activity alone even in the presence of high-level beta activity, and beta activity in the presence of alpha.

Standard chamber of the unit will take samples in any shape up to a maximum of $2^1/_4$ in. diam $\times$ $^7/_{16}$ in. thick. The instrument is readily adapted to smaller, thinner samples or filter papers or similar samples that can be prepared in cylindrical shape up to 10 in. long and approximately 2 in. diam.

Yield of the unit is as high as can be obtained in flat sample counting, the company says. Sensitivity is five to fifty times that of end window Geiger-Mueller tubes, and does not vary with time, temperature or humidity. Background count is the lowest available in commercial devices—approximately one-third that of a Geiger-Mueller tube—the firm states.

Decontamination of the unit can be quickly accomplished. It can be disassembled, decontaminated and reassembled in less than ten minutes. Clean parts may be substituted for contaminated parts in a matter of seconds. Net weight of the PCC-14 is 30 lb. Dimensions are $7^3/_4 \times 16^1/_2 \times 10^1/_4$ in.

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***...the result of operating experience with the first...***

A large Midwest utility contracted for their first Consolidated chimney in 1950 when its newest station was erected to meet the constantly increasing demand for power. It is a 292 ft. by 11 ft. tapering concrete chimney with acid-proof brick lining and was built quickly and economically. It has met all demands of the boilers and has performed with complete satisfaction under all conditions.

It was but natural, therefore, that when continually increasing demand required the installation of additional boilers that Consolidated should again be commissioned to erect an exact duplicate of the original chimney.

Consolidated is proud of this installation and of the many other chimneys it has designed and erected in its quarter-century of service to the industrial leaders of America—companies that are familiar to everyone* and whose standards are known to every consulting engineer, architect and general contractor. Designed by men who know their business, erected with painstaking care to exact specifications, Consolidated chimneys give performance and service year in and year out to meet the most exacting requirements.

**Consolidated designs and builds chimneys of all types and all sizes—Perforated Radial Brick, Tapering Reinforced Concrete, Face and Common Brick, Acid Proof, High Temperature; installs linings for steel stacks, waterproofs, repairs and rebuilds, installs lightning rods and aircraft warnings; demolishes chimneys. Whatever your chimney problem may be, Consolidated has the experience, the knowledge and the skilled personnel to handle it.**

**Phone, wire or write today** *for information. Ask for catalog giving installations, engineering service, chimney design data and specifications.*

*Gladly supplied upon request.

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**The most advanced developments in electronics are being made in the sphere of airborne radar and related ground control systems because of military emphasis.**

*Further applications of electromechanical techniques in these fields are creating new openings in the Systems Division of Hughes Research and Development Laboratories.*

Engineers who have demonstrated ingenuity and inventive ability will find interest in areas of work that call for devising reliable, maintainable, manufacturable designs for precision equipment developed at Hughes Research and Development Laboratories.

The design of this equipment, manufactured at Hughes, involves mechanical, electromechanical, electronic, microwave and computing problems. Design also requires the use of such advanced techniques as subminiaturization, unitized "plug-in" construction, with emphasis on design for volume production. Knowledge of electronic components, materials, finishes and military specifications is useful.

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## Precision Potentiometer

A new high-precision 10-turn potentiometer said to have a very favorable cost-quality factor has been introduced by the Spectrol Electronics Div., Carrier Corp., 1704 S. Del Mar St., San Gabriel, Calif.

The unit was designed for accuracy and constructed to meet the most rigid government specifications, including heat, humidity, shock, vibration and life, the company states.

Model 800's standard linearity tolerances and standard resistance tolerances are 3 per cent.

Special linearity tolerances to .025 per cent and special resistance tolerance to .5 per cent are available to meet special requirements.

Aluminum lids, either bushing or servo, machined to close tolerances, are carried in stock. Special lids are available. Housings are laminated phenolic plastic. Stops are machined from 303 stainless steel, and capable of withstanding 1000 in. per oz. As many as three sections can be easily gaged. As many as 50 additional taps per section can be provided.

## Nylon Stop Nut

Announcement has been made of a new nylon stop nut, by The American Screw Co., Willimantic, Conn. Its applications are of a special interest to the electrical, chemical, electronic, medical, photographic, appliance, metal furniture manufacturers, and transportation industries.

Identified as the Brilok Nylon Stop Nut, it is a one-piece, washer-faced resilient hexagon nut which is simultaneously self-tapping, locking and insulating. According to the manufacturer, it is molded to American Standard Flats Widths Dimensions for use with standard installation and removal tools.

Completely re-usable, the new nut is said to be ideal for presetting. As the screw turns into the resilient material, the material is displaced and a counter-compressive force is exerted against the screw as continuing drive-torque is applied, resulting in a tight friction lock. At the same time, a new design principle reportedly aligns the screw in the hole, holding it tightly against wobble, chatter, noise, and vibration.

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BUSINESS NOTES
LATEST CATALOGS

## Diamond Tools

Hamilton Watch Co., of Lancaster, Pa., announces that its Allied Products Div., is now in commercial production on a line of diamond tools for machining small precision metal parts. These tools are designed for machining to extremely close tolerances and for producing a machined surface of mirror-finish smoothness.

The line includes a number of turning tools for cutoff and for finish-turning of flat or bevelled surfaces; a series of laps for machining the inside surfaces of holes to achieve precise diameter and very fine finish; and a variety of disks and wheels for precision external machining.

The turning tools are available for any type of cutoff operation and for finishing of flat surfaces or bevelled surfaces of any desired bevel angle. The laps are available in sizes varying from .018 to 2.250 in. in diameter. Wheels and disks are available up to 2.250 in. in diameter.

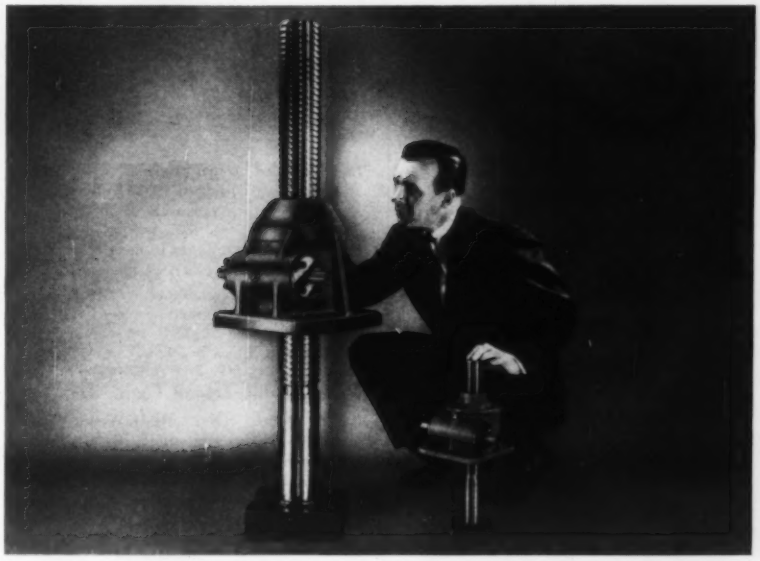
The company says the tools for metal turning have wide application for machining soft metals to tolerances of .010 in., and for producing a machined surface so smooth that no polishing or other finishing is required. The laps are used for producing holes of precise diameter and smooth finish in metal dies used for precision metal stamping.

## Plane Swivel Joints

Introduction of a new line of lightweight, low cost small size swivel joints, designed especially for hydraulic or pneumatic service on pipe, tubing, or hose, is announced by Barco Mfg. Co., Dept. J-23, 500 N. Hough St., Barrington, Ill.

The company says the new joints are of the "single plane" swivel type, in contrast with its flexible "self-aligning" swivel type. They are designed, primarily, to provide for up to 360-degree turning or rotating motion on machinery or other places where flexible piping or tubing is required. Their chief advantage, the company says, is that they provide for long service life without maintenance or replacement. They can be used as connectors for hose in reducing hose length by eliminating sharp bends and increasing hose life by relieving all twisting stresses.

The firm is producing the new joints in ball bearings and thrust bearing types suitable for pressure as high as 2,000 psi, depending on size of joint. Temperature ratings

**Here's A Device Every Machinery Designer Should Know About . . .**

It's the Duff-Norton Worm Gear Jack, successfully used by many machine builders as a component of equipment for precise, positive control of linear motion, applying pressure, resisting impact. Two or more of these jacks can be connected by means of shafting and mitre gear boxes or any power-operated positive control system so that jacks always raise or lower under equal or unequal loads in perfect unison. Capacities range from 5 to 35 tons with any raise up to 25 inches; worm gear ratios, 8:1 to 96:1; turn of worm for each 1-inch raise, 10 to 180; available in either Acme or square threads. Screw ends and tops are available in many types and can be readily adapted to your specific requirements.

Thousands of these jacks are in use today for table adjusting—machine adjusting—rolling mill adjusting—raising and lowering conveyors, machine beds, molds and dies, furnace lids, loading platforms, loading racks, gates, hinged mechanisms, arbor presses—adjusting electrodes—overhead crane servicing.

Duff-Norton Worm Gear Jacks are available in 6 standard sizes or to your special order. For complete specifications and detailed drawings, send for your free copy of a special brochure.

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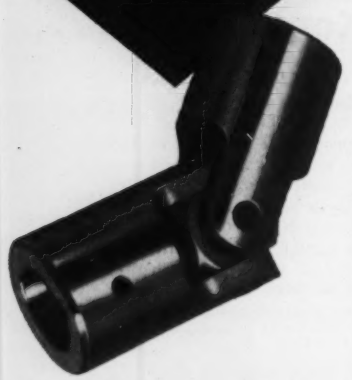

You can lower your operating costs with A.S.G. Universal Joints direct from your distributor. American Stock Gear Universal Joints are designed and built to the highest standards of quality and accuracy.

All A.S.G. Universal Joints are provided with self-locking retaining rings on the small pin. This simplifies assembly and disassembly. No rivet pins are used. They are available from stock in 13 sizes with bored or solid hubs ranging in diameter from .375" to 4.000". Special bores, bores with keyways or setscrews are available on special order.

***Ask for Bulletin No. 527 describing the full line of A.S.G. Universal Joints.***

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recommended range from −20 F to 225 F. The joints are equipped with O-ring seals and have low rotating torque at all pressures. The bearings are sealed and require no lubrication maintenance in normal service.

Standard sizes are $^1/_4$ and $^1/_2$ in., and $^3/_8$ and $^3/_4$ in. are available on quantity orders. The joint casing is machined from aluminum and the rotating shaft from steel. Overall length of the $^1/_4$-in. is $2^3/_4$ in.

## New Carbide Tipped Tools

Besly-Metro Div., Besly-Welles Corp., Beloit, Wis., has announced the availability of its new carbide tipped tool catalog. It contains 12 pages of charts and descriptions of the various types, sizes, and styles of standard and special carbide tipped tools offered by the company.

In addition to the specific information included on the firm's products, the new catalog contains data on carbide tipped tools in general and many illustrations of their proper application.

## Air, Water Hose

A new, high visibility hose of braided wire construction for extra safety at pressures to 2000 psi has been announced by Manhattan Rubber Div., Raybestos-Manhattan, Inc., Passaic, N. J.

The company says the hose is strong enough for air actuating service on the heaviest machinery and loading equipment, yet light and flexible enough for pneumatic tools. It is built with special steel braids said to offer maximum resistance to accidental crushing in mine and quarry service.

## Hard-Facing Material

A new nickel-chromium-boron-tungsten hard-facing material which provides parts exposed to extreme conditions of vibration and/or heat with a wearproof, corrosion-resistance surface is now available from Wall Colmonoy Corp., 19345 John R St., Detroit 3, Mich. It is named Colmonoy No. 70 and is said to have a high tungsten content which hardens the matrix, giving it improved heat and vibration-resistant properties.

Originally developed to overcome fretting and fretting corrosion at temperatures of 1000 F and more on jet engine shafts, the material is also recommended by the company for use in engine valves, chemical valves, acid pump parts, coal washers and cement screws, as well as in other jet engine applications. It also provides a superior wear-resistance surface for handling scouring type loose abrasives, the company claims.

Colmonoy No. 70 is available as a powder for application by spray-welding or as welding rod in $^3/_{16}$, $^1/_4$, $^5/_{16}$ and $^3/_8$-in. diam for application with an oxy-acetylene torch flame. It is also available as castings. The new alloy produces a surface whose hardness ranges from 50 to 55 Rockwell C; specific gravity is 8.5; melting point is approximately 2000 F.


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*No lubrication required.* Quickly installed. Easily replaced. Cushions are reversible—can be changed or reversed without shutdown. Fractional to over 2400 hp. Light, medium or heavy duty.

**Variable Speed Pulleys:**

*Quickly installed on new or old equipment.* Change speed while machine is running. Ratios to 3 to 1. Fractional to 15 hp.

**Select-O-Speed Transmissions:**

*Economical as compared to other variable speed transmissions.* Instant adjustment over wide range of speeds. Hand wheel or lever control. Ratios to 10 to 1. Fractional to 5 hp.

**Universal Joints:**

*Precision ground.* Finest alloy steel. No binding, backlash or end play. 13 sizes, fractional to 207 hp. Bores ¼ to 2 in. Lengths 2 to 10⅝ in.

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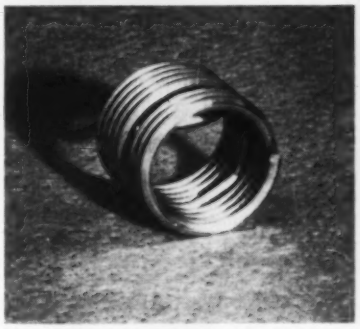


## Locking Insert

A new "Mid-grip" screw-lock insert developed by the Heli-Coil Corp., Danbury, Conn., is said to eliminate lock-washers, lock-nuts and locking wires, and provide strong, permanent, wear-resistant threads in light metals, plastics, steel, and cast iron.

The company says the "Mid-grip" insert requires no more boss diameter or wall thickness than a conventional tapped thread, and that it can easily be incorporated into an otherwise frozen design.

The new insert is a companion product to the firm's original wire screw thread insert. Both are made of precision-formed stainless steel. Both provide 60-deg threads. Both are installed with similar tools by the same methods.

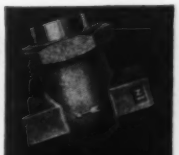
The new insert exerts a strong locking effect on a screw fastener because one or two coils in the middle of the insert are generally octagonal instead of being perfectly round, the company says. As the screw passes through this area, the gripping coils are forced to assume a circular shape. The chords of the circle press on the screw, giving the locking effect which is not diminished through many cycles of disassembly. The locked screw may be freed by applying breakaway torque approximately the same as used in the original assembly. It is not necessary to seat the gripping coils with a special tool.

The company says the new inserts provide internal threads so wear-resistant they permit the substitution of ordinary cap screws for studs. The insert is said to be dimensionally stable over a wide temperature range and resists wear, corrosion, galling and seizing. It is immediately available in sizes 10-32; $^1/_4$-28; $^5/_{16}$-24; $^3/_8$-24, with other sizes in NC and NF series through $^1/_2$ in. scheduled for availability shortly.

## Tubular PI Filters

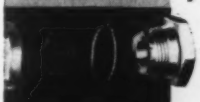
A new series of "Quietone" PI filters in tubular cases has been made available by the Cornell-Dubilier Electric Corp., South Plainfield, N. J.

These metal-cased, hermetically-sealed tubular type filters, in the threaded-neck mounting style, afford high insertion loss values for the suppression of radio noise, the company claims. They are made to the smallest possible sizes and minimum weight

**ELECTROFLO VALVE**
An electrically operated valve for controlling on and off flow of fluids. For large flow volume.

**SHUR-FLO INTERLOCK**
A control to protect equipment when flow is below a desired minimum; or above a desired maximum.



**MESURFLO CONTROL**
A flow volume control to deliver one set rate of fluid flow, regardless of variable inlet pressures.

**ELECTRO-MITE VALVE**
A direct action solenoid valve for small flow volume. Available with volume control.

**STRAITFLO STRAINER**
A straight line strainer, installed in the supply having the entire strainer area within the flow way itself.

**ELECTRO-MESURFLO VALVE**
An electrically operated valve with flow volume control. For medium flow volume.

*New*
**AUTOMATIC FLOW CONTROL *for* WATER**

**If your problem concerns a specified flow of fluid or time-fill, we suggest you design Hays *automatic* flow controls into your equipment. Hays products are trouble-free and offer absolute internal water control. They are low cost, and eliminate the need for such components as pressure regulators, filters, and other devices.**

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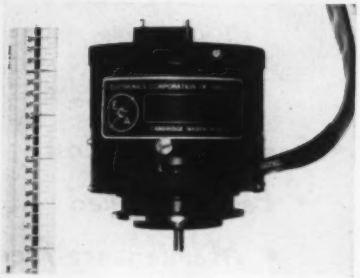
**ERIE, PA.**

for the stated ratings and attenuation characteristics. The listing offers a selection of current ratings ranging from .1 to 50.0 amp. Voltages are 28, 50, 100, 300 and 500 d-c; and 115 and 125 a-c. Frequencies are 60, 400, and 1000 cycles per sec.

The company says the flatted, threaded neck provides easy, convenient mounting to a panel or bulkhead through a round or slotted hole, and simultaneously affords an excellent ground connection to shunt unwanted currents. Use of slotted hole mounting is said to prevent the filter unit from turning or jogging loose.

The tubular feed-thru PI filters listed in the company's Bulletin 171 are "manufacturer's standard" types with glass sealed lug terminals. Variations can be supplied by the firm to meet specific design and application requirements.

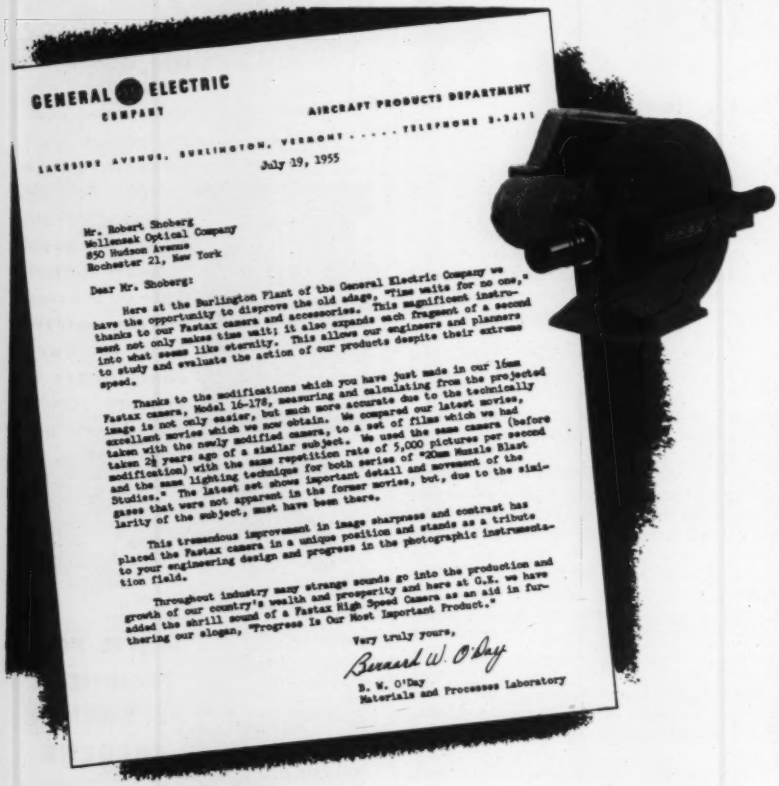


## Analog-Digital Converter

A lightweight, 13-channel encoder has been developed by Electronics Corp. of America, Cambridge, Mass., for reading shaft positions to an accuracy of 1 part in 8192. The company says the instrument may be applied where the position of rotating shaft is required either as an input to some controlling device, or for real-time data reduction.

Output of the converter is in cyclical-binary code, which may be recorded or otherwise processed in that form, or converted to some other form.

The converter employs no slip rings or moving contacts, no gears, and no circuits in which the accuracy of any one reading depends on that of a preceding reading. Instead, photoelectric means are employed to pick off shaft position with no frictional drag on the shaft. A glass disk is mounted directly on the shaft, and is very accurately scaled into a code of transparent and opaque areas. These areas constitute a pattern of 13 channels forming the cyclical-binary code. The firm says a very useful property of this code is that between successive angular positions of the disk there is a change in but one of the binary digits: hence, potential ambiguity or error of the readings cannot under any circumstances exceed one-half of one discrete position. Readout is made at any desired rate up to 100 per sec.



GENERAL ELECTRIC COMPANY
AIRCRAFT PRODUCTS DEPARTMENT
LAKESIDE AVENUE, BURLINGTON, VERMONT ..... TELEPHONE 3-5411
July 19, 1955

Mr. Robert Shoberg
Wollensak Optical Company
850 Hudson Avenue
Rochester 21, New York

Dear Mr. Shoberg:

Here at the Burlington Plant of the General Electric Company we have the opportunity to disprove the old adage, "Time waits for no one," thanks to our Fastax camera and accessories. This magnificent instrument not only makes time wait; it also expands each fragment of a second into what seems like eternity. This allows our engineers and planners to study and evaluate the action of our products despite their extreme speed.

Thanks to the modifications which you have just made in our 16mm Fastax camera, Model 16-178, measuring and calculating from the projected image is not only easier, but much more accurate due to the technically excellent movies which we now obtain. We compared our latest movies, taken with the newly modified camera, to a set of films which we had taken 2½ years ago of a similar subject. We used the same camera (before modification) with the same repetition rate of 5,000 pictures per second and the same lighting technique for both series of "20mm Muzzle Blast Studies." The latest set shows important detail and movement of the gases that were not apparent in the former movies, but, due to the similarity of the subject, must have been there.

This tremendous improvement in image sharpness and contrast has placed the Fastax camera in a unique position and stands as a tribute to your engineering design and progress in the photographic instrumentation field.

Throughout industry many strange sounds go into the production and growth of our country's wealth and prosperity and here at G.E. we have added the shrill sound of a Fastax High Speed Camera as an aid in furthering our slogan, "Progress Is Our Most Important Product."

Very truly yours,
Bernard W. O'Day
B. W. O'Day
Materials and Processes Laboratory

"FASTAX Cameras make time wait... allow us to study and evaluate action"

Similar letters from many companies and research laboratories tell what an important part Fastax High-Speed Cameras are taking in the design and engineering of their products. Recent improvements in the cameras make them even more important engineering tools.

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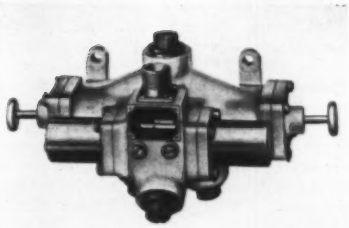

## Solenoid Selector

Aircraft Products Co., 300 Church Rd., Bridgeport, Pa., announces its Series 7300 four-way pilot-operated, solenoid selector valves for 3000-psi hydraulic service. The company says the new valves feature low current draw, low leakage and positive actuation.

Intended primarily for use with MIL-O-5606, APC Series 7300 selector valves are provided with AND-10050-4, −6, −8 ports for 1/4, 3/8, 1/2 in. tube sizes. These valves are available with the following variations: with or without manual override; three-position spring centered; two-position spring offset; three-position detent; with thermal relief; and with special spool and sleeve combinations to meet individual porting requirements.

The weight saving features of these pilot-operated units have been combined with a pressure balanced main valve to provide a compact, lightweight valve requiring low current drain. Spool and sleeve elements have been precision finished to assure low leakage and positive actuation. A simple, trouble-free ball poppet is employed in the pilot valve section. The main valve section is designed to provide low pressure drops and positive valve actuation, even at low system pressures. The entire unit is constructed from corrosion resistant materials.

The ambient temperature range of the standard valve is from −65 to 160 F. Valves with wider temperature ranges are available on special order. These continuous duty valves are provided with single coil solenoids operating in the range of 18 to 30 v direct current.

## Electronic Comparators

A new ball-bearing measurement attachment for use with the company's Micro-Ac ultra-precision electronic comparators is announced by Cleveland Instrument Co., 735 Carnegie Ave., Cleveland, Ohio.

The new attachment gages ball bearings of from 1 mm up to 1 1/2 in. diam to an accuracy of 1/2 millionth of an inch. In addition to gaging ball diameter, the equipment can be used for random sphericity gaging.

Essentially, the attachment is a V-shaped block mounted at a slight angle to permit the ball to roll into a chute after completion of the gaging operation. A manually operated lever moves the ball into the gaging position under the Micro-Ac gage head. The manufacturer points out that since the ball is untouched by hand, there is no possibility of heat transfer to cause inaccuracies nor is there any "etching" of the ball from acid hand perspiration. The gage head contact tip pressure is 4 oz to prevent work distortion. A precision-lapped compound screw provides for fine adjustment of the head, and a positive stop gives over-travel protection.

Movement of the contact tip displaces a linear-voltage, differential transformer. This produces a signal which is directly proportional to the amount of displacement of the contact tip from its zero position. This signal goes to the dual-sensitivity amplifier, the output of which is fed to the amplifier meter (or recorder) to show both the amount and direction of displacement either side of the zero position. The two amplifier sensitivities give direct meter readings of .000001 or .0000005 in. Meters calibrated in microns or other units are available on special order.


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. . . 28-page illustrated booklet contains factual information on methods of fire detection, fire prevention, fire control and fire extinguishment.

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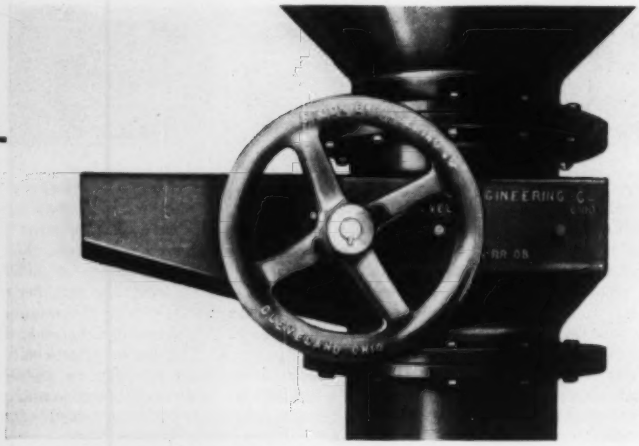

VALVES THAT BIND AND JAM are a constant problem in many plants. You can solve this problem by using S-E-Co. Bulk Material Valves on your hopper and bin outlets and downspouts. Even fine or dusty materials won't clog the self-cleaning racks and pinions in this valve. No wonder so many chemical plants specify S-E-Co. when replacing old cut-off valves or adding new. Descriptive and dimensional data on the S-E-Co. Bulk Material Valve may be obtained by writing for our new bulletin No. 105.

**STOCK Equipment Company**

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If you are qualified by experience, are eligible for secret clearance, and are interested in any of the following categories in design, development or drafting, please write for further information to: Robert L. Ehinger, Rex Division, 9851 So. Sepulveda Boulevard, Los Angeles 45, California.

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THE GARRETT CORPORATION
REX DIVISION
*Los Angeles 45, California*

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## Liquid Level Control

Machinery Electrification, Inc., Northboro, Mass., has announced the development of the MEK-3001A electronic liquid level control for the general processing industries.

In an effort to keep maintenance time to a minimum, the MEK-3001A incorporates a plug-in relay encased in a transparent cover. This cover permits inspection of the circuit operation at any time as well as preventing the entry of dust or other foreign matter which may effect relay operation. The control can be connected for pump-up, pump-down, or constant level service. It will monitor any liquid whose resistivity is between 0 and 2,000,000 ohms per centimeter cube. Shock hazard is eliminated since the probe voltage is less the 12.5 v and is completely isolated from the a-c power supply by a transformer. The control can be supplied in enclosures to meet all NEMA requirements. Where desired, these enclosures can be provided in type 316 stainless steel. As a supplement to the unit, the company also carries a complete line of probe assemblies for all types of applications.

## Transistor Test Set

Baird Associates, 33 University Rd., Cambridge 38, Mass., announces a new transistor test set, Model GP. The company says the new model provides dependable, rapid, accurate measurement of transistor characteristics at any frequency from 100 cps to 1 megacycle. It is especially designed with the precision required by the transistor laboratory and versatility so important to the circuit designer.

The transistor test set permits measurement of NPN and PNP junction, surface-barrier and point-contact transistors in grounded-base and grounded-emitter circuits. Measurements of hybrid coefficients T-network coefficients, collector saturation current, collector capacitance, alpha and beta cutoff, voltage feedback ratio, open circuit resistances, and channel effect voltage can be simply, accurately made with Model GP, the company says.

The functional panel design of the Model GP permits rapid adjustment of test conditions, and a large, polarity-indicating meter facilitat s fast accurate readings, the company says. The transistor test set employs unique circuitry and long-life batteries to reduce measurement errors. Bias conditions are variable over wide ranges to facilitate testing of the units under various conditions.

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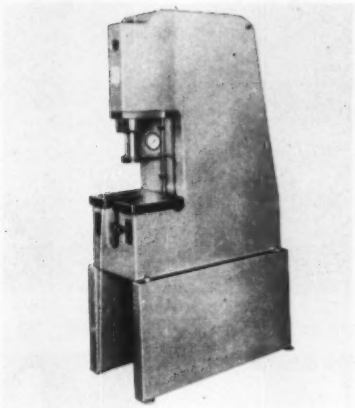


## Hydraulic Presses

A new line of high speed hydraulic presses designed for fast production and which will give up to 520 in. per min closing and return speeds has been announced by Northern Tool and Machine Co., 1545 N. 31st Ave., Melrose Park, Ill.

The company says the controls of the presses are sensitive to the touch; yet the ram can be slowed down or stopped at any point. At the bottom of the work stroke the hand or foot may be removed from the control, and the ram will return to a predetermined setting.

The units are made in 10- and 20-ton capacities. The length of stroke can be set from $^1/_2$ to 2 in. Ram speed closing is rated at 55 to 520 in. per min. Pressing is 55 to 200 in. per min, and return is 110 to 520 in. per min.

The units are available in hand, safety dual-hand or foot controlled models, the 10-ton size can be furnished electrically controlled.

## Segmented Transfer Machine

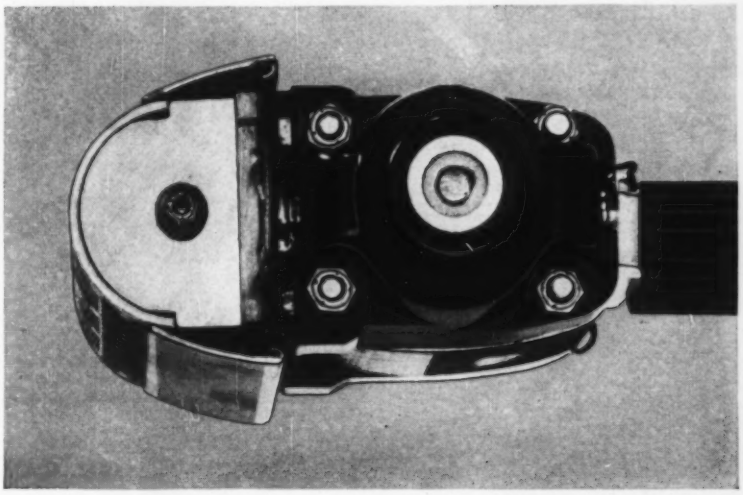
A compact segmented transfer machine that includes a unique vertical angular rail arrangement to avoid turnover operations, and utilize horizontal way units in the complete milling, drilling, and tapping of a cast iron automotive engine intake manifold has been designed and built by Snyder Tool & Engineering Co.; 3400 E. Lafayette Ave., Detroit 7, Mich.

By turning the intake manifold up on edge and transferring it from station-to-station with a transfer bar arrangement, all machining operations on the part are performed without turning it over. The company says this design concept cuts the overall length of the machine, avoids turnover fixtures, lets chips fall away from the part by gravity and permits rugged horizontal way units to perform the machining operations.

The intake manifolds are transferred on vertical angular rails that travel the length of

*Continued on Page 74*

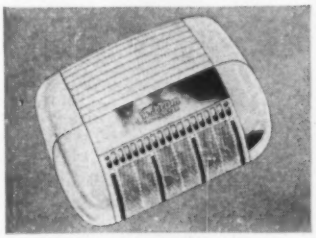

FASTENER PROBLEM



# Self-locking fasteners for limited clearance applications

The cutter shaft of the Sunbeam Electric Shaver moves the cutting blades at about 9000 RPM. The double nuts previously used to fasten the pitman arm to this shaft had to be really tight. With the pressure of high volume production, improper tightening sometimes caused bent shafts—and frequent thread stripping.

A single true miniature ELASTIC STOP® nut, only .080" high and .125" across flats (ESNA No. 99-1660-12, 1-72 thread) is used to replace the double nuts. The action of ESNA's red elastic locking collar permits locking anywhere on the shaft for simple and completely accurate adjustment . . . and eliminates thread stripping. This simple, direct locking action avoids production-time losses due to bending; and saves the cost of the rejected shafts as well.



A separate series of reduced-dimension hex nuts are used on the "field" studs fastening motor to frame (ESNA No. 99-2399-38). This size 3-48 nut is .130" high and .187" across flats. The stop nut eliminates lock washers and further shortens assembly time. Solution of this multiple fastener problem illustrates ESNA's ability to supply an efficient, vibration-proof, self-locking fastener to meet almost any dimensional requirements.

MAIL COUPON FOR DESIGN INFORMATION

ESNA

Dept. N91-211, Elastic Stop Nut Corporation of America
2330 Vauxhall Road, Union, New Jersey

Please send me the following information:

☐ Details on ESNA miniature and reduced dimension nuts
☐ ELASTIC STOP® nut bulletin
☐ Here is a drawing of our product. What fastener would you suggest?

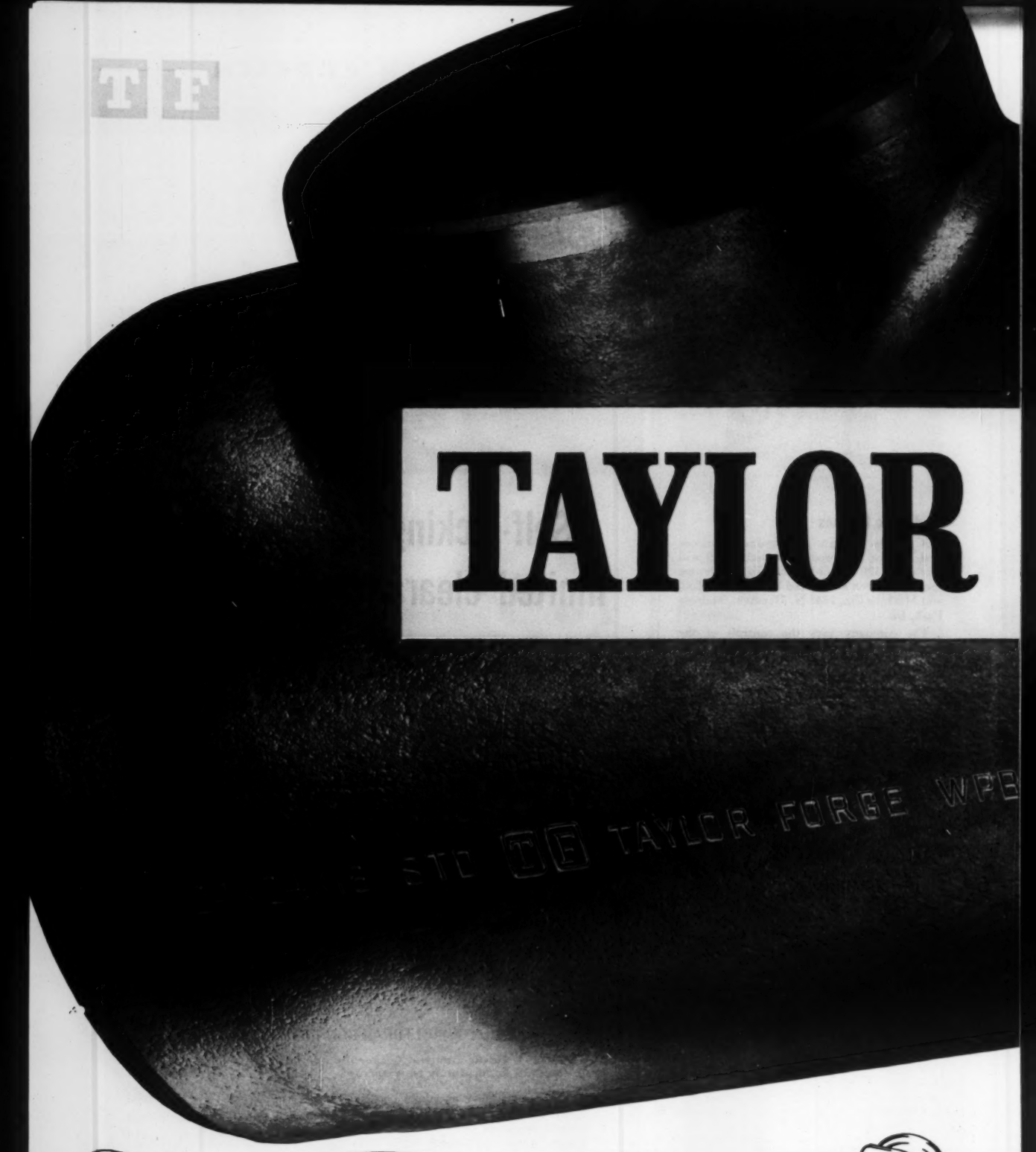
Name_____ Title_____

Firm_____

Street_____

City_____ Zone____ State_____

# TAYLOR



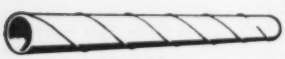
Welding nozzles

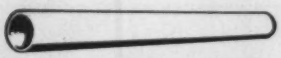
T.E.M.A. flanges and channels

Multiple outlet headers

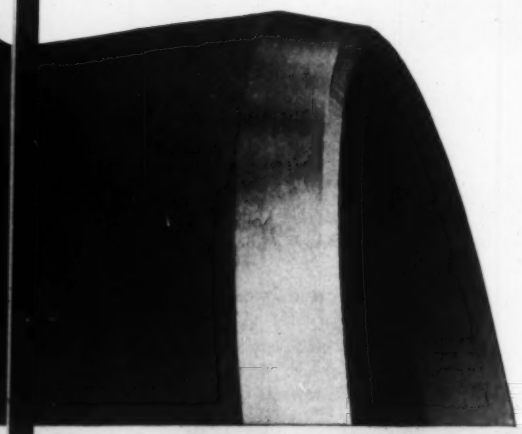
Production forgings

Venturi reducers


Spiral weld pipe


Large diameter electric weld pipe

Welding necks



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**Built for maximum service...**

***to make any good piping job BETTER***

# FORGE

## Welding Fittings and Forged Flanges

By any method of value analysis . . . by any measurement of quality . . . by any standard of comparison . . . you can't buy finer products than those made by Taylor Forge. The line, truly complete, includes WeldELLS and all other welding fittings of any thickness, many in sizes through 42" O.D.; forged and rolled flanges of any required diameter and pressure rating; multiple outlet headers; venturi type reducers, hot tap tees; anchor flanges; in fact, just about everything you need to simplify piping construction and speed up the job.

To be sure . . . . turn to Taylor Forge . . . . ***"traditionally dependable."***

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Plants at: Carnegie, Pa.; Gary, Ind.; Houston, Texas; Fontana, Calif.; Hamilton, Ont., Canada.

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### For the *best* of service call your Taylor Forge Distributor

He carries a full stock of Taylor Forge Welding Fittings and Forged Flanges and can supply your needs promptly. He's a good man to know for he understands piping and through him you have available the services of Taylor Forge engineers for help and advice on any piping problems.

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Contains helpful information on design uses, and prices of Chromalox Electric heaters, elements, thermostats, contactors and switches.

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the hydraulically operated electrically controlled machine. Previously milled flat surfaces on the manifolds contact the rail surfaces. Retaining strips on top and bottom ways prevent the manifolds from falling away from the rails.

The seven-segment, 20-station, 54-ft long machine produces 68 manifolds per hr at 80 per cent efficiency, the company says. Individual bases and control panels are used for each segment, and the machine has individual hydraulic power units for each segment and a master control panel that integrates the functions of the individual control panels.

## BUSINESS NOTES

### Industrial Distributor

The appointment of Ross-Willoughby Co., Columbus, Ohio, as industrial distributor for its line of machinery mounts is announced by Barry Controls Inc., Watertown, Mass., manufacturer of shock and vibration isolation equipment. The distributors will handle Barry's leveling machinery mounts and spring mounts.

### Names Representative

Flexonics Corp., Maywood, Ill., announces the appointment of Thermo Tech Products Co., Denver, Colo., as its exclusive representative for the lines of Flexon expansion joints and expansion compensators for the state of Colorado and southeastern Wyoming.

### Acquires Welded Pipe Firm

U. S. Industries, Inc., has acquired Southern Pipe & Casing Co., near Azusa, Calif., a manufacturer of welded steel pipe for the transmission of water, oil, and gas. The acquisition follows by less than a month the company's acquisition of Garrett Oil Tools, Inc., of Longview, Tex.

### Chiksan Representative

Malcolm W. Black Co., Inc. has been appointed representative for Chiksan Co., Brea, California, with territory comprising Southern New York and Northern New Jersey. The Black organization will handle the entire line of Chiksan and WECO products. Malcolm W. Black & Co., Inc. has headquarters at 41 E. 42nd St., New York, N. Y.


**For Consulting Engineers**

**turn to Page 166**



***Whether we***

## "NEED IT OR NOT"

*Frank Sorensen Jr.*

TREASURER, THE CINCINNATI GEAR CO.

In one way we're a little like the old-timer who religiously took a bath every Saturday—whether he 'needed it or not.' We take somewhat the same attitude towards the replacement of our gear manufacturing equipment. We purchase new equipment and tools and retire old machines on a regular calendar basis, even though the old ones may seem adequate for further use. It is all too easy to slip into the habit of putting off purchase of a new unit because the old one still has "lots of use left in it," or is still "relatively" efficient. By prodding ourselves into the purchase of new equipment on a 'schedule' we have avoided this pitfall, and today we have as modern and efficient gear manufacturing facilities as any in the industry. Even our factory buildings (have you ever seen our plant?) reflect this constant striving for the better and the more efficient—for our present plant, built in 1942, replaced a plant that then was a relatively modern installation.

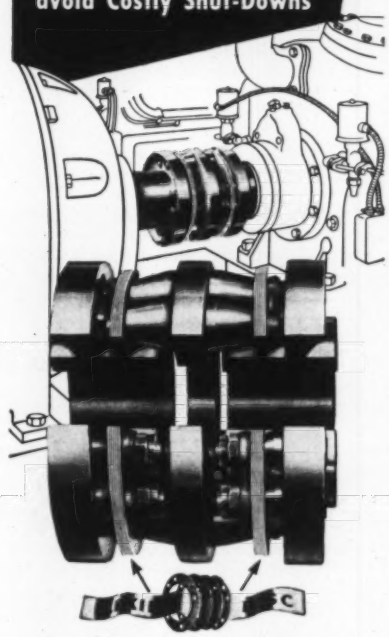
Just as the fellow who took the Saturday night bath was not out of step with the world 50 or 75 years ago, neither was the firm who bought their production machinery "to last." Today, however, the march of technological progress has become so fast and so relentless that we cannot afford to be content with what we have; an aggressive modernization policy is a *must*. We've built up a reputation for producing the best in custom gears, and for producing them efficiently—and we intend to keep that reputation in years to come.

**THE CINCINNATI GEAR CO.**

CINCINNATI 27, OHIO

*"Gears—Good Gears Only"*

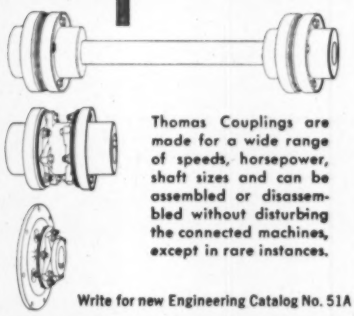
Specify THOMAS ALL METAL
FLEXIBLE COUPLINGS
for Power Transmission to avoid Costly Shut-Downs



Patented Flexible Disc Rings of special steel transmit the power and provide for parallel and angular misalignment as well as free end float.

DISTINCTIVE ADVANTAGES

| FACTS | EXPLANATION |
|---|---|
| NO MAINTENANCE | Requires No Attention. Visual Inspection While Operating. |
| NO LUBRICATION | No Wearing Parts. Freedom from Shut-downs. |
| NO BACKLASH | No Loose Parts. All Parts Solidly Bolted. |
| CAN NOT "CREATE" THRUST | Free End Float under Load and Misalignment. No Rubbing Action to cause Axial Movement. |
| PERMANENT TORSIONAL CHARACTERISTICS | Drives Like a Solid Coupling. Elastic Constant Does Not Change. Original Balance is Maintained. |



Thomas Couplings are made for a wide range of speeds, horsepower, shaft sizes and can be assembled or disassembled without disturbing the connected machines, except in rare instances.

Write for new Engineering Catalog No. 51A

THOMAS FLEXIBLE COUPLING CO.
WARREN, PENNSYLVANIA, U.S.A.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## Merger Completed

Square D. Co. and Electric Controller and Mfg. Co. have formally began operations as a merged corporation.

Square D, as the surviving company, will operate Electric Controller as a separate division, and becomes one of the nation's largest manufacturers of electrical distribution and control equipment. Executive offices are at 6060 Rivard St., Detroit 11, Mich.

## P & W Buys Die Firm

Pratt & Whitney Co., Inc. has purchased the assets and business of Sterling Die Co., Cleveland, Ohio.

Sterling henceforth will be operated as the Sterling Die Division of the Pratt & Whitney Co. No changes in plant location or in operating personnel are contemplated. The newly acquired firm manufactures thread rolling dies.

## Appoints Distributors

The appointment of five new pump distributors has been announced by Ampco Metal, Inc., Milwaukee, Wis. The appointments are: Will Process Equipment Corp., Rochester, N. Y.; The Condit Co., Tulsa, Okla.; A-L Machine and Equipment Co., Franklin Park, Ill.; Rawdon Myers Agency, Cincinnati, Ohio; Paul B. Duggan, Chicago, Ill.

## Winsmith, Inc., Purchases New Plant

Winsmith, Inc., Springville, N. Y., announces the purchase of the complete plant of the Foote Construction Equipment Div. of Blaw-Knox Co., at Nunda, N.Y., which Blaw-Knox has been operating since 1948. The plant was originally operated as Foote Brothers Co.

The facilities consist of more than 78,000 sq ft and will more than triple present manufacturing space. The Nunda operation will be known as the Buffalo Assets Corp., Subsidiary of Winsmith, Inc.

## Names New Representative

Morris Machine Works of Baldwinsville, N. Y., manufacturer of heavy duty slurry pumps, has named Cross Pump & Equipment Co., Charleston, W. Va., as its sales representative in the southern half of West Virginia, eastern Kentucky, and western Virginia.

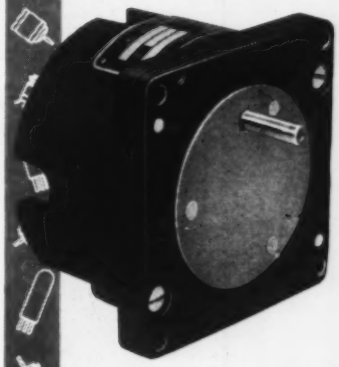
## Organizes New Department

Formation of a new manufacturing department of the General Electric Co., the Medium Transformer Dept., with headquarters at Rome, Ga., has been announced.

Effective Jan. 1, the Rome plant of the Power Transformer Dept. will become a separate product department, responsible for its own engineering, manufacturing and marketing.


READY MADE GEAR SYSTEMS

...FOR THE WIDEST RANGE OF CUSTOM USES



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KEEP INFORMED

NEW EQUIPMENT
BUSINESS NOTES
LATEST CATALOGS

## Moves to Collegeville

T. J. Cope, Inc. and its wholly-owned division, Instrof Corp., have moved manufacturing operations from Philadelphia to Collegeville, Pa.

The firm, which had been at 711 S. 50 St., Philadelphia, 70 years, decided to leave when increased business dictated substantial expansion in manufacturing facilities. The Collegeville plant will double production space and output for Cope. Plans call for sales and executive offices to be moved to Collegeville in April.

LATEST CATALOGS

## Globe Valves

Gyroseal Valve, Div. of Richmond Foundry & Mfg. Co., Inc., 1300 Hermitage Rd., Richmond 20, Va., has issued a booklet illustrating and describing its line of globe valves which feature a spinning disk, dual purpose seat and line contact between seat and disk.

The disk spins rapidly at the moment of closure, generating centrifugal force which throws off scale and other foreign particles. As the spinning disk touches the seat the two surfaces are lapped together to create a complete metal-to-metal contact designed to prevent leaking and regrinding of the disk and seat. Valves listed include those of 200, 300 and 350 lb WSP.

## Welding Machines

Linde Air Products Co., Div. of Union Carbide & Carbon Corp., 30 E. 42nd St., New York 17, N. Y., has available a 32-page bulletin illustrating and describing its Oxweld cutting machines. It is designated as No. F-4487.

Included are photos and specifications covering high-precision shape cutting machine, other shape cutting machines, shape welding carriage, portable cutting machines and carriages, automatic, and magnetic tracing units.

## Dust Filters

Koppers Co., Inc., Metal Products Div., Baltimore 3, Md., has published Bulletin 304 illustrating and describing its Model D dust filters, complete with fan with capacities of 520 to 4800 cfm at 20 to 1 filter ratio.

The units feature automatic, pressure-controlled, reverse-air-jet filter cleaning. In operation, dust-laden air from a manifold enters filter drums which have heads of tightly stretched felt. The dust is left on the inside of the drums and is then drawn from the drum housing by the main blower. The dust is dislodged from the drum heads by a reverse air jet and falls through a slot in the bottom of the filter drum into the dust filter hopper.

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NEW EQUIPMENT
BUSINESS NOTES
LATEST CATALOGS

## Steel Tubular Heaters

Mammoth Furnace Co., 509 Vandalia St., St. Paul 4, Minn., has issued a booklet illustrating and describing its line of direct-fired space heaters with capacities from 300,000 to 2,000,000 Btu, and steel tubular heaters with capacities from 175,000 to 413,000 Btu.

Included in the booklet are specifications and price lists, along with dimensional diagrams. The company recommends the heaters for churches, schools, factories, auditoriums, and commercial buildings.

## Time-Fill Diagrams

Hays Mfg. Co., Industrial Sales Div., W. 12th St., Erie, Pa., has issued Folder No. 209, covering a series of specific time-fill diagrams to assist engineers in calculating time-fill requirements.

The diagrams show requirements in minutes, quarts, and pints for various valves up to 150 psi.

## Separators, Exhaust Heads

Wright-Austin Co., 3245 Wight St., Detroit 7, Mich., has issued Bulletin 400 covering its line of separators, exhaust heads, traps and strainers, boiler trimmings.

Units are illustrated by cutaway photographs and dimensional drawings. Specifications are in table form.

## Shuttle-Drive Conveyors

A four-page bulletin issued by the Industrial Filtration Co., Dept. SD-200, Lebanon, Ind., covers shuttle-drive conveyors and gives technical details on this new type oscillating conveyor for industrial applications.

Units are available in stationary or portable models which are hydraulically and mechanically operated. The unit operates with any trough or trench. Mechanically or hydraulically operated shuttle-drive bar rests on the bottom at either side or the center. Hinged to the drive bar at intervals are blades which open to the width of the trough as the drive bar starts its forward movement. The blades advancing with the drive bar move material in the trough to the maximum forward stroke of the drive bar. As the movement is reversed, the blades fold back against the drive bar and by-pass the material advanced by the blade in back. As the forward stroke is again begun, the blades open and advance the material in successive steps.

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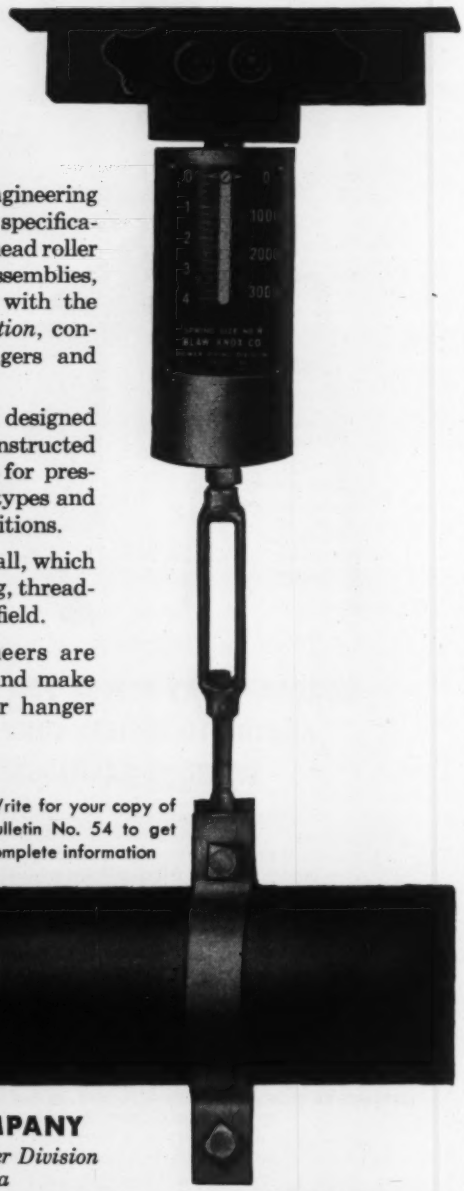
# you save engineering time

## with complete hanger assemblies



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KEEP INFORMED — NEW EQUIPMENT, BUSINESS NOTES, LATEST CATALOGS

### Bellows Assemblies

Clifford Mfg. Co., Dept. ME, Waltham 54, Mass., has issued a brochure illustrating and describing its line of complete bellows assemblies.

Included is a section dealing with the design considerations of metal bellows and details on cup assemblies, differential pressure bellows assemblies, shaft seals, packless valves, and expansion joints.

### Coal Dust Control

Wheelabrator Corp., 1149 S. Byrkit St., Mishawaka, Ind., has pubished a booklet on the control of dust from coal handling operations.

It discusses the use of local exhaust ventilation and cloth-tube-type dust collectors. This method is applicable to such operations as the conveying and preparation of coal for burning in industrial plant or power plant furnaces and boilers; the conveying, screening, and weighing of coke for charging foundry cupolas; the conveying, screening, crushing, weighing, and batching of coal in chemical processing; and the like. Four illustrated case histories are presented. Some diagrams of materials handling systems and how dust control is exercised in them are presented.

### Transformer Laminations

The seventh edition of the Allegheny Ludlum "Transformer Laminations" book is now being distributed and has been revised and expanded to 120 pages.

The book gives detailed information and drawings on 100 different standard lamination shapes made by the organization. Such items as direction of grain, count and weight of laminations, magnetic and mechanical dimensions, lamination die layout, as well as other important data are included in this book. A copy can be obtained by writing the Sales Dept., Allegheny Ludlum Steel Corp., 2020 Oliver Bldg., Pittsburgh 22, Pa.

### Flow Calculations

A new manual, "AGA Flow Constants," for orifices where flange taps are used, has been published by Foxboro Co., Foxboro, Mass., to speed the computation of orifice sizes, coefficients, and flows. It is priced at $10 per copy.

Compiled as a supplement to "Principles and Practice of Flow Meter Engineering" by L. K. Spink, the manual contains a total of 77,811 separate flow calculations evaluated to six figures. These include values of S for an infinite Reynolds number, values of E, and values of K, derived from the equations developed by Dr. Buckingham and used by AGA and ASME. Figures are presented in d/D steps of 0.001 from 0.100 to 0.800 for each of 37 lines sizes from 1.535 in. ID to 29.25 in. ID. The 111 pages of tables were photographically reproduced from calculations made by automatic computer machines.

KEEP INFORMED

NEW EQUIPMENT
BUSINESS NOTES
LATEST CATALOGS

### Unplasticized Vinyl

H. N. Hartwell & Son, Inc., Park Square Bldg., Boston, Mass., has issued a folder of application studies in Boltaron 6200, an unplasticized polyvinyl chloride.

The folder contains photographs of installations using the material in chemical processing plants throughout the nation.

### One-Shot Lubricators

Detailed description and operating mechanism of pull-type semi-automatic lubricators are described in a two-page, two-color service instruction sheet offered by Bijur Lubricating Corp., Rochelle Park, N. J.

One-Shot lubricators, designated as Types HIB and JIB, are described in the sheet. These medium range units have a 1-pt and 2-pt. reservoir capacity respectively, and are equipped with a pull handle. The lubricators are used on machines requiring closely controlled but infrequent oil feed. Servicing as many as 100 lubrication points, One-Shot systems are used on textile machinery, small punch presses, and many special types of machines.

### Air Conditioning

A 16-page illustrated bulletin on the construction, operation, and application of Seazonaire remote room air conditioning units has been published by Marlo Coil Co., 6137 Manchester Ave., St. Louis 10, Mo. The units are designed to provide individually controlled units for use in hotels, motels, institutions, office buildings, and other multiple installations.

The bulletin gives construction details, performance characteristics, photographs, drawings, and other pertinent data, on floor and ceiling type models, free standing, and recessed.


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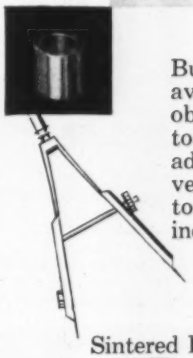
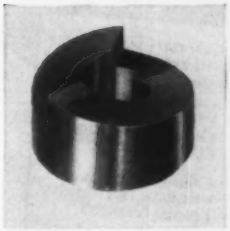


Bunting Engineering is available without cost or obligation to all who wish to use or explore the cost advantages that this versatile product brings to the mechanical industries.



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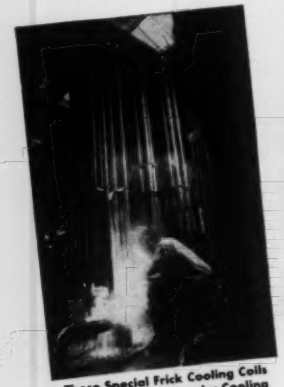
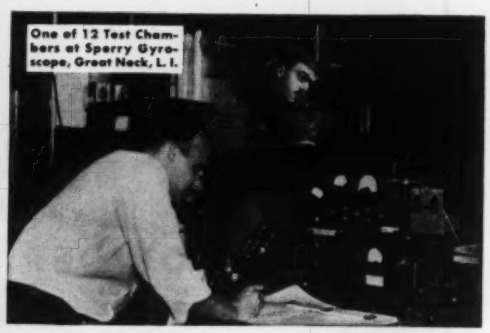


These Special Frick Cooling Coils Are Making History by Cooling Synthetic Rubber Twice as Fast



One of 12 Test Chambers at Sperry Gyroscope, Great Neck, L. I.

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KEEP INFORMED — NEW EQUIPMENT, BUSINESS NOTES, LATEST CATALOGS

## Magnetostriction Transducers

A new, illustrated booklet entitled "Design of Nickel Magnetostriction Transducers" has been issued by the Development and Research Div., International Nickel Company, Inc., 67 Wall St., New York 5, N. Y.

The booklet summarizes practical experiments to guide the engineer toward a workable design in exploring new fields in the sonic and ultrasonic regions. A magnetostrictive transducer is used to convert electrical input energy to mechanical output energy or mechanical input energy to electrical output energy.

## Supersonic Heat Transfer

A new technical bulletin summarizing the results of an experiment in determining convective heat transfer on a supersonic airframe through use of a V-2 rocket in flight is now available from the General Electric Company's Special Defense Projects Dept., 2900 campbell Ave., Schenectady 6, N. Y.

Designated 55SD3, the bulletin describes the procedures and equipment used in the experiment, and is fully illustrated with graphs presenting data on skin temperatures, pressures measured on the V-2 nose cone, and the altitude and velocity reached during the missile flight.

## Piping Flexibility

How processing and power piping costs can be reduced substantially in materials, design, and construction is the subject of a new 12-page brochure published by The M. W. Kellogg Co., 225 Broadway, New York, N. Y.

The publication details the firm's "general analytical method of piping flexibility analysis," which the company says represents one of the most comprehensive approaches devised for evaluating stresses, reactions and deflections in complex piping networks. This analysis involves the development and solution of simultaneous equations for determining forces and moments in the piping system. From these forces and moments, stresses and deflections are calculated. Since the analyses are not based on approximations or "short-cut" calculations, it is possible to specify more closely to the theoretically perfect piping design, thereby avoiding excessive and costly margins of safety, the company says.

## Automatic Valve

Hydraulic valves, solenoid controlled and panel mounted, are illustrated and described in a new catalog, No. 261, published by Rivett Lathe & Grinder, Inc., Brighton 35, Boston, Mass.

Included in the catalog is a complete file on panel mounted solenoid valves, emphasizing features of construction and operation with cutaway views, piston designs, spools, JIC symbols, interchangeability of parts. Working drawings are clearly illustrated on one page for convenience; all specifications are diagrammed.

KEEP INFORMED

NEW EQUIPMENT
BUSINESS NOTES
LATEST CATALOGS

## Chemical Pumps

The firm's line of small rotary displacement and centrifugal pumps for chemical service is described and illustrated in a revised bulletin prepared by Eco Engineering Co., 12 New York Ave., Newark 1, N. J.

Among the units which are detailed in the four-page folder are Type 316 and Type 20 stainless steel, and Hastelloy C positive displacement pumps, synthetic rubber and bronze low-volume rotary pumps and Type 20 stainless steel centrifugal pump. Interchangeable impellers for diverse chemical service with the firm's positive displacement line are listed. They include Teflon, Hypalon, Neoprene, Formica, and graphitized carbon for processing corrosive or hazardous fluids. A table of recommended uses, complete specifications for each unit and photographs of numerous conventional drives and mountings are also contained in the booklet.

## Compression Spring

Preliminary design data for the Flex'ator, a compression spring which is said to exert the same force at any deflection, is presented in a 16-page engineering bulletin published by Hunter Spring Co., Lansdale, Pa.

Subjects discussed include characteristics and properties of the spring, materials, types of ends, methods of mounting, design formulas, and design standards. Four tabular form design charts, each representing a different fatigue life requirement, or stress level, are included as are specification instructions.

## Grating, Stair Treads

An illustrated report on the usage of steel, aluminum, and stainless grating and stair treads has just been published by the Klemp Metal Grating Corp., Dept. SP, 6601 S. Melvina Ave., Chicago 38, Ill.

The brochure discusses various types of electroforged welded grating and contains dimensional sketches and data on riveted grating. These products are used in such industries as the marine industry, power houses, chemical industry, factory maintenance, petroleum industry, light and heavy construction, mining, railroads trucking, transportation, safety, and food fields. Also discussed is bridge decking and various types of anchors suggested for grating installations.

## Steam Generators

Type WTP shop-assembled water tube steam generators are detailed in a new 14-page bulletin. Available from Titusville Iron Works Co. Div., Struthers Wells Corp., Titusville, Pa.

These 2-drum boilers are shop assembled and shipped as a package unit with all components installed. They are produced in steam capacities of from 7500 to 40,000 lb per hr. The bulletin includes technical data, a dimensional drawing with table of dimensions, a drawing showing tube arrangement and gas passes, and illustrations of all basic components.


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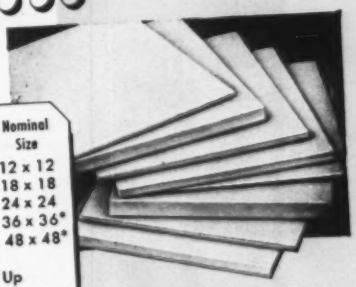
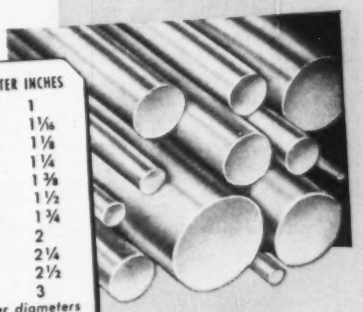


| Thickness Inches | Nominal Size |
|---|---|
| 1/16" | 12 x 12 |
| 3/32 | 18 x 18 |
| 1/8 | 24 x 24 |
| 3/16 | 36 x 36* |
| 1/4 | 48 x 48* |
| 3/8 | |
| 1/2 & Up | |

* Can be furnished in 1/2 sheets

SHEET



| DIAMETER INCHES | |
|---|---|
| 1/4 | 1 |
| 5/16 | 1 1/16 |
| 3/8 | 1 1/8 |
| 7/16 | 1 1/4 |
| 1/2 | 1 3/8 |
| 9/16 | 1 1/2 |
| 5/8 | 1 3/4 |
| 3/4 | 2 |
| 7/8 | 2 1/4 |
| | 2 1/2 |
| | 3 |

Other diameters on specification

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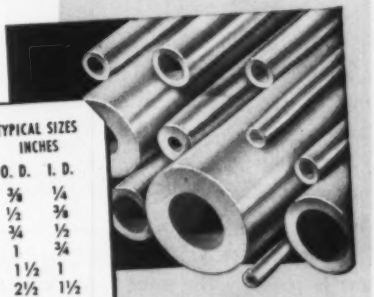

| TYPICAL SIZES INCHES | |
|---|---|
| O. D. | I. D. |
| 3/8 | 1/4 |
| 1/2 | 3/8 |
| 3/4 | 1/2 |
| 1 | 3/4 |
| 1 1/2 | 1 |
| 2 1/2 | 1 1/2 |
| 3 | 1 3/4 |

TUBING

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**CHEMICAL**
Completely inert.

**ELECTRICAL**
Very high dielectric strength.
Extremely low power factor.

**THERMAL**
Temperature range
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**MECHANICAL**
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**LOW COEFFICIENT OF FRICTION**
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There are three jobs for every two engineers in this country. It's an engineer's dream . . . and therein lies a danger.

For this simply means that it's easier than ever before to make a mistake in the company and the job you choose.

If you're wise, you'll realize that the move you make now is possibly the most important in your business life. Hence, you'd do well to look closely into the *management* of any company you're considering. Then take a careful look at the *future* of the job you're offered.

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MARTIN
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KEEP INFORMED — NEW EQUIPMENT, BUSINESS NOTES, LATEST CATALOGS

## Multi-V Belt Care

A 14-page illustrated manual on the care and maintenance of industrial V-belts has been published by B. F. Goodrich Co., Industrial Products Div., Akron, Ohio.

The manual covers the following topics: designing the new drive; double matching; installation of belts; how V-belts grip; importance of tension; drive alignment; how to clean; storage. A V-belt service chart, which illustrates typical causes of belt failure, is featured. Full-scale photographs show what belts look like after failure. Ways to prevent typical causes of belt failure are outlined.

## Capacitor Fuel Gages

A booklet covering capacitor type fuel gaging systems has been made availabe by Liquidometer Corp.

The new booklet describes true weight gaging systems, compensated and uncompensated capacitor type fuel gages, repeater indicators, fuel gage totalizing systems selective indicators and thermistor applications for fuel level warning and control. Copies may be obtained from Liquidometer Corp., Dept. S., Skillman Ave. & 36th St., Long Island City 1, N. Y.

## Vacuum Valves

Kinney Mfg. Div. of New York Air Brake Co., 3640 Washington St., Boston, Mass., has announced Bulletin 401 describing its series of bronze, cast iron, and fabricated steel bellows-sealed vacuum valves.

The two-color bulletin contains engineering drawings, cutaway and exploded views of the valves, and general dimension charts.

## Sealing Grips

Pyle-National Co., 1336 N. Kostner, Chicago 51, Ill., announces the availability of a new six-page pamphlet describing its watertight line of high-luster finished sealing grips for portable cords and cables used with all types of electrical equipment. The bulletin describes in detail the variety of conduit and cable sizes in five body types.

## Air Conditioning

The development and use of self-contained central station air conditioning are given comprehensive coverage in a new 36-page booklet published by United States Air Conditioning Corp., 3300 Como Ave., SE, Minneapolis 14, Minn.

Called "Why RK?" the two-color publication traces the history of comfort cooling in nontechnical terms from the days of the Romans. It discusses the evolution of present day techniques culminating in the RK unit, a single compact device which contains, in one casing, all of the elements of a central air conditioning plant up to 60 tons in cooling capacity. The booklet describes the operation of the refrigeration cycle and its application in "built-up" systems and in packaged air conditioners.

KEEP INFORMED

NEW EQUIPMENT
BUSINESS NOTES
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### Carbon Rings

Koppers Co., Inc., Metal Products Div., Baltimore 3, Md., has issued a four-page bulletin illustrating its Huhn carbon rings for steam turbines.

The rings are tapered for positive suspension, have high radial sealing surface, are tongue-and-groove type, and provide clearance for radial motion, the bulletin says.

### Valves Catalog

A new 12-page two-color catalog listing all of the bronze or Milvaloy Valves for the oil industry was recently issued by the Milwaukee Valve Co., 2375 S. Burrell St., Milwaukee 7, Wis.

The catalog lists more than 150 valves, has 59 illustrations, and provides easy-to-read specifications and data on all valves listed. Sizes and applications for each valve are given in chart form. Valve accessories such as flanges, fill caps, couplings, swing joints, and bushings, are also shown.

### Vinyl Plastic Paint

A new catalog page describing "Seal-Kote" vinyl plastic all-purpose paint is announced by Wooster Sealkote Co., Wooster, Ohio.

Illustrated with action photos and line sketches, the new bulletin recommends the paint for a wide range of applications around homes, farms, and industry. Among these are painting cement and cinder blocks, concrete, brick, asbestos shingles, new and old wood, plaster, wallboard, celotex, stucco, all types of masonry, stone, wallpaper, and asphalt. According to the bulletin, "Seal-Kote" can be applied on either wet or dry surfaces, inside or out. When used on damp masonry, it is reputed to prevent further water penetration.

### Moisture Measurement

How to measure water vapor in air and other gases is the subject of a 12-page bulletin released by Pittsburgh Lectrodryer Corp., Box 1766, Pittsburgh 30, Pa.

Discussed are the gravometric, dew point and wet and dry bulb methods as well as some less used and even experimental schemes.

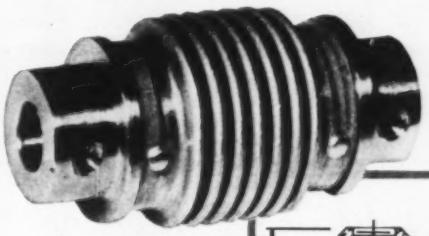
### Rubber Linings

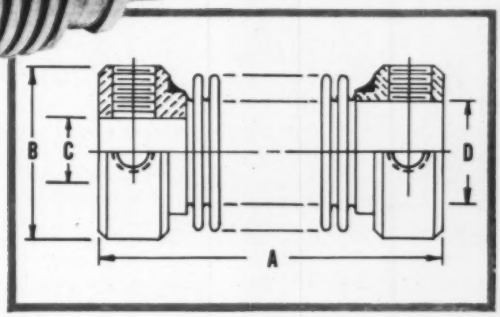
A new catalog of corrosion, abrasion, and contamination resistant rubber linings for tanks, pipe, valves, and similar storage and process equipment has been issued by Manhattan Rubber Div., Raybestos-Manhattan, Inc., Passaic, N. J.

The illustrated catalog contains charts, tables and diagrams, and specifications and suggestions covering tanks for the chemical, process, and plating industries. It also contains suggestions for effecting economies in the bulk handling of chemicals, and a complete guide for the proper selection of lining for use with a wide variety of acids, alkalies, plating solutions and abrasive compounds.


FLEXON BELLOWS *Design Briefs*

# How to Select and Specify Flexon Bellows for Use in Low Torque Couplings






**FLEXON OFFERS THE COMPLETE BELLOWS SERVICE**

Flexonics Corporation manufactures a complete range of bellows and bellows assemblies in brass, bronze or stainless steel for vacuum equipment, thermostatic devices, pressure controls, packless valves, pneumatic instruments, hydraulic mechanisms, rotating shaft seals and many other services.

*The Flexon Bellows Design Guide gives valuable application and design information. Write for your copy, today.*

Flexon Bellows offer the designer an economical means of coupling shafts when torque is low. The inherent flexibility of the bellows compensates for angularity and misalignment at a cost well below conventional methods.

However, because of the torque limitations certain basic considerations are necessary:

*Allowable O.D. of bellows and/or shaft fittings*
*Allowable overall length including fittings*
*Maximum torque on bellows*
*Maximum misalignment*
*Frequency of rotary motion*
*Temperature range*

With this data, Flexonics can develop bellows type couplings to fill a wide variety of needs, economically. Submit the data outlined above and Flexonics will design the bellows coupling to meet your requirements.

**Flexonics** *Corporation*

FLEXON BELLOWS DIVISION
1305 S. THIRD AVENUE • MAYWOOD, ILLINOIS
FORMERLY CHICAGO METAL HOSE CORPORATION

Flexon identifies products of Flexonics Corporation that have served industry for over 53 years.

Manufacturers of flexible metal hose and conduit, expansion joints, metallic bellows and assemblies of these components.
In Canada: Flexonics Corporation of Canada, Ltd., Brampton, Ontario

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If you are stuck in a job without a future, it will pay you to investigate the wide variety of openings in our engineering department.

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Fill in and mail the attached coupon immediately. We'll treat it confidentially; reply without delay. Your action now may be the first step toward a far better future for you and your family.

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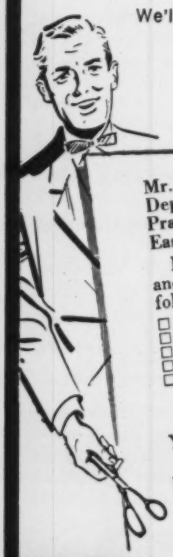

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Dept. 8, Design Employment
Pratt & Whitney Aircraft
East Hartford 8, Conn.

I would like to learn more about your openings for product and component designers. My experience has been in the following fields:

☐ Nuclear Design
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*World's foremost designer and builder of aircraft engines*


KEEP INFORMED — NEW EQUIPMENT · BUSINESS NOTES · LATEST CATALOGS

## Precision Castings

A new five-page folder, detailing its facilities, policies, and personnel, is now available from the Engineered Precision Casting Co., Box 68, Matawan, N. J.

The literature, which was occassioned by the 10th anniversary of the company, highlights the major events during the growth of the firm, illustrates its key personnel, and details its recently introduced tooling charge rebate plan.

## Cylinders, Valves

The firm's line of Allenair cylinders, valves, clamps and dial feed indexing tables is featured in a new illustrated catalog issued by The A. K. Allen Co., 57 Meserole Av., Brooklyn 22, N. Y.

Described are a complete range of valve-in-head, single and double ended cylinders; solenoid, pilot, and hand air valves; spring return clamp and three different models of dial feed tables. The bulletins, together with price sheets, are spiral bound into a master catalog.

## Small Air Pump

Dexter Folder Co., Pearl River, N. Y., offers a new bulletin covering its "Dri-Air" pump and air filters. The pump is especially designed for applications having low cfm requirements at pressure from 20 in. Hg to 10 psi.

Included in the bulletin are illustrations showing rotary pump and air filter construction, and a specification table giving speed, capacity, maximum vacuum, and continuous maximum pressure for three pump models. Data is given for 12 operating conditions ranging from 3.5 to 33.2 cfm.

## Welding Fittings

Tubular Products Div. of Babcock & Wilcox Co., Beaver Falls, Pa., has issued a six-page folder, FB-500, which furnishes the types and size ranges of various welding fittings and flanges which can be supplied by the division.

## Phenolics Film

"Molding Phenolics" is a new 20-minute, 16-mm sound film produced by Bakelite Co., Div., Union Carbide and Carbon Corp.

The technical film is designed specifically for use in industrial plants and technical schools. The company says it brings together for the first time the entire range of artisans, craftsmen, and technicians who contribute to the production of phenolic molded articles. While the film presents a simple step-by-step discussion, designed primarily to familiarize new employees with phenolic molding processes, its scope is so wide that even those workers who have had long experience in the field may find it enlightening. Prints may be borrowed free from Bakelite Co., Technical Film Library, 292 Madison Ave., 10th Floor, New York 17, N. Y.

# KEEP INFORMED

NEW EQUIPMENT | BUSINESS NOTES | LATEST CATALOGS

## Filtration Manual

A comprehensive manual of filtration especially written for product designers is available from Purolator Products, Inc., Rahway, N. J.

The new manual describes numerous filter applications and deals with such design considerations as flow rates, viscosities of fluids, and contamination to be removed, as well as filter costs, space requirements of the designer, types of filter elements, and the proper selection of elements. A glossary of filtration terms is also included in the manual which contains numerous illustrations and charts. Twenty-five cents to cover postage and handling should accompany requests for this manual.

## Welded Steel Pipe

Alco Products, Schenectady, N. Y., has issued an eight-page bulletin on electric welded steel pipe for water, gas, and steam installations.

Included is data on the firm's manufacturing methods, dimensions and specifications of the pipe, and photos of applications of the pipe in intake stations, municipal water systems and reservoirs.

## Cemented Carbides

A four-page mailer on Carmet cemented carbides which features four charts on carbide properties is being distributed by Allegheny Ludlum Steel Corp., 2020 Oliver Bldg., Pittsburgh 22, Pa.

One chart compares crater resistance, edge wear resistance, and shock resistance on the new Carmet steel cutting grades. A chart on the harness and strength vs. cobalt content is included.

## Radial Ball Bearings

Basic dimensions and dynamic capacities for more than 300 standard radial ball bearings and more than 50 other standard ball bearings are illustrated and tabulated in a new condensed, supplementary catalog published by Miniature Precision Bearings, Inc., Keene, N. H.

Twenty-one standard types of miniature ball bearings are described in detail in the four-page, three-color publication. In addition, the catalog discusses bearing materials, tolerances, operating speeds, and load ratings. The company's free engineering services are described, and nationwide representatives of the firm are listed.

## Photoelectric Cell

A booklet on the Kodak Ektron detector, a unique type of photoelectric cell which utilizes the peculiar electric properties of lead sulfide, has been prepared by the Eastman Kodak Co., Rochester 4, N. Y.

The detector was first introduced in 1954 and is now being used in various military and commercial devices. It is characterized by its small size, mechanical ruggedness, and high sensitivity to radiation in the infrared, visible, and ultraviolet portions of the spectrum. Particularly outstanding, research has shown, are its extreme sensitivity to heat radiation and its absence of mechanical microphonics. Because of the method of manufacture, it is possible to produce detectors in complex, exact arrays, and mosaics.

## Silicone Rubber

An eight-page bulletin describes the line of silicone rubber products made by the Garlock Packing Co., Palmyra, N. Y.

Applications described include molded and extruded parts for appliance, automotive and aircraft products, and industrial seals. The firm produces thin wall extrusions of silicone, and makes silicone sponge rubber.

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SPRAY NOZZLES
performance-proved for every operation
Take advantage of the wide choice of spray nozzle types and capacities supplied by Spraying Systems to meet your needs exactly. Actually tens of thousands of precision, standard spray nozzles to choose from. Every kind of spray pattern.
STRAINERS . . . high efficiency line strainers in all standard capacities.
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A complete 48 page catalog with specifications on all standard and pneumatic atomizing nozzles. The most complete spray nozzle reference manual ever printed.
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Straight Line Draft Gage
Special Synthetic Coated Silk Fabric Diafram Lasts for a Generation.
• Non-parallax pointer—always true readings regardless of elevation.
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Plus 10 Other Features described in Bulletin 124.
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THE ELLISON LINE ALSO INCLUDES:
Draft Gages, Bell and Diafram—Inclined Draft Gages—Portable Inclined Vertical Tube Gages—Vertical Tube Gages—Oil, Heavy Liquid and Mercury—Single and Multi-Tube-Saturator Gages—U Gages—Stationary and Portable—Air Filter Gages—Dial and Inclined Tube Types—Pitot Tubes—U Path Steam Calorimeters—Portable Gas Analyzers-Orsat Type
ELLISON INSTRUMENTS—Outstanding Design, Construction and Accuracy

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NEW EQUIPMENT | BUSINESS NOTES | LATEST CATALOGS

## Vibration Control

Isolant, a line of vibration control material, is described and illustrated in a catalog released by T. R. Finn & Co., Inc., Industrial Div., 200 Central Ave., Hawthorne, N. J.

The material is recommended by the company for massive, difficult to isolate machinery because it provides effective isolation of the combination of vibration, shock, and noise, due to its high structural strength and resiliency. The catalog describes the granular structure of Isolant, which is made up of millions of hermetically-sealed minute air cells that expand or contract in accordance with the applied load.

## Glass Fiber Products

A new catalog with a complete, condensed explanation of its many products and their applications has been issued by L. O. F. Glass Fibers Co., 1810 Madison Ave., Toledo, Ohio.

The catalog describes and illustrates uses of the company's Microlite and Super Fine blanket insulatious for thermal and acoustical treatments. In addition, it has references to Microflex compressed board, a resilient cushion material; quartz and glass Micro-Fibers, reinforcements for plastics and yarns for the textile industries.

## Steam Trap Selected

A 12-page bulletin designed specifically to aid in the selection and application of steam traps on chemical processing equipment is now available from Yarnall-Waring Co., Chestnut Hill, Philadelphia 18, Pa.

The bulletin features a three-page fold-out piping diagram for 22 pieces of typical processing equipment—each showing recommended steam trap and piping arrangements. Trap selector tables for these and other pieces of chemical processing apparatus are also included.

## Airtube Systems

Lamson Corp., Syracuse 1, N. Y., announces the release of a new catalog, "Airtube On Target." It is a 50-page, multicolored, hard covered book describing the several sizes of Airtube systems, central desk and the semi and automatic switch systems as well as the variety of carriers that are available.

An entire section is devoted to describing in detail the variety of carriers offered. Included are outline diagrams of each type carrier. Another section is made up of several case history reports of typical installations in a cross section of industries.

## Barometric Condensers

Barometric condensers, for removing air, exhaust steam, and other vapors from vacuum equipment, are described in a new bulletin, 5AA, available from Dept. J-U, Schutte and Koerting Co., Cornwells Heights, Bucks County, Pa.

The bulletin covers condenser theory, basic condenser types—concurrent (parallel flow) and counter-current (counter-flow), features of all types and styles, application and construction information, and condenser operation. Also included is information on selecting condensers under varying conditions.

## High Frequency Combustion

A new bulletin fully describing a high frequency combustion unit for rapid determination of total sulfur in diesel fuel, kerosene, oil sludges, lubricating oils, lubricating oil additives, tars, asphalts, spent caustics, catalysts, and other inorganic materials has been issued by the Laboratory Equipment Div., Lindberg Engineering Co., 2450 W. Hubbard St., Chicago 12, Ill.

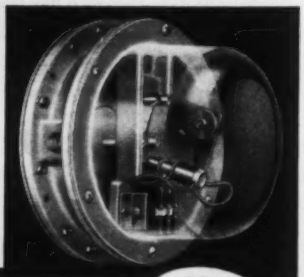
The method used for determining total sulfur in petroleum product is outlined including specifications and a listing of accessories to comprise a package unit.


**BIN-FLO AERATING UNIT**

Provides Steady Flow of Dry, Finely Ground Materials which tend to bridge in storage. Uses only small amount low-pressure air.

**BIN-DICATOR BIN LEVEL INDICATOR**

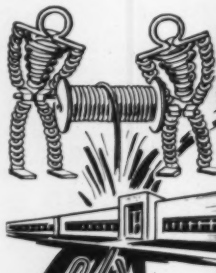
For All Bulk Materials



signals change in level; automatically starts and stops filling and emptying equipment.

**THE BIN-DICATOR CO.**
13946-W Kercheval • Detroit 15, Mich.

NEW DETAIL DATA BOOK FREE



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NEW EQUIPMENT | BUSINESS NOTES | LATEST CATALOGS

## Non-Metallics Data

A new bulletin issued by Polymer Corp., of Pennsylvania, Reading, Pa., describes its full line of nylon, Teflon and specialty nonmetallics in terms of properties and characteristics.

The materials are presented in such stock shapes as rod, strip, tubular bar, slab, flexible tubing, tape and plate for machining into final form. Each product family is illustrated to show the shapes available. Standard size ranges are also given. Specific uses are described, along with the advantages of fabricating from stock shapes.

## Hydraulic Testing Machines

Universal testing machines are presented in a new 12-page bulletin, 4401, by Baldwin-Lima-Hamilton Corp., Philadelphia 42, Pa. Hydraulic machines with capacities from 10,000 to 5,000,000 lb are described, including standard and special types of vertical and horizontal machines.

A feature of the booklet is an illustrated explanation on hydraulic loading and the independent hydraulic weighing system, which is based on the Emery cell and the precise Tate-Emergy null-balance load indicator.

## Rubber Handbook

What is said to be the first design handbook of its kind ever produced on rubber and rubber like products is available from Lavelle Rubber Co., 424 N. Wood St., Chicago 22, Ill.

The book contains specially prepared data on the characteristics and uses of various types of base polymers, as well as their relative resistance to specific chemicals. Another feature of the book is the inclusion of actual rubber and rubber-like swatches presenting various degrees of hardness from Shore Duro 25 to 95. In addition, 18 color swatches are presented to show standard colors in which rubber parts can be produced.

## Solenoid Pilots

Spence Engineering Co., Inc., Walden, N. Y., has issued a four-page bulletin describing several types of solenoid pilot for use with the firm's regulating valves.

Listed are reasons for economies in on-off control, application data, and material of construction, maximum pressure and maximum temperature for two- and three-way pilots in steam, air, gas, and liquid service. Schematic diagrams of typical applications are also offered.

## Solder-end Valves

A circular illustrating and describing its new line of five bronze, solder-end valves is available from Lunkenheimer Co., Box 360, Cincinnati 14, Ohio.

Designed as a companion line to screwed-end gate valve series, the new solder-end valves are said to be particularly adaptable for service in schools, hospitals, apartments, hotels, and all types of commercial structures as well as a wide range of industrial applications. The valves embody such features as the firm's "Non-slip" handwheel, long wearing "Stemalloy" stem, handy hexagon head gland, back seats permitting repacking under pressure, leak resistant extra deep stuffing box and corrosion resistant close grained bronze.

## Pump Maintenance

Helpful hints on maintenance of initial pump efficiency and choosing a dredge pump that best fits a particular need are discussed in a new bulletin describing the "GA" and "GAF" dredge pumps of Morris Machine Wks., Baldwinsville, N. Y.

The Bulletin, No. 184-A, outlines the 24 models in this line which range from 6-in. to 20-in. size.


for FAST...LOW COST...ACCURATE...SAFE stamping around periphery of round metal parts

MODEL GRD-960-2

STAMPING FIXTURE

Here's your answer for fast, economical marking of the periphery of round parts up to 5" in diameter. Cradles and mandrels are used depending on part marked. Also adaptable to marking of flat parts.

Write for Bulletin 646!

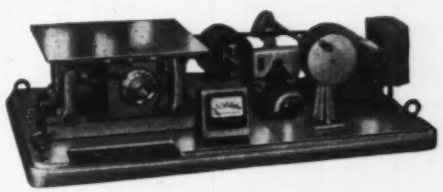
Mecco SAFETY MARKING TOOLS

M.E.CUNNINGHAM CO.

1473 NORTH AVENUE, PITTSBURGH 33, PA.



Range Selector Is Highlight Of All American Model 100 HLA-D Vibration Fatigue Test Machine



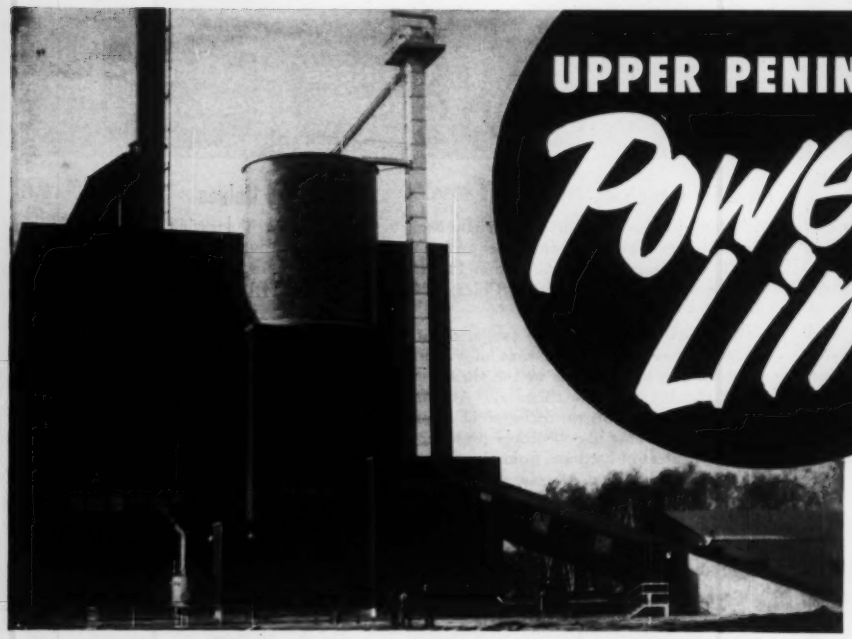
This machine subjects parts or assemblies, up to 100 lbs. in weight, to a comprehensive vibration fatigue test. It has a 50% overload safety factor. Vibration in simple harmonic motion is produced horizontally. Displacement (double amplitude) is adjustable from 0" to 125". Automatic Range Selector controls acceleration and deceleration. From 10 cycles per second frequency may be increased uniformly to 60 c.p.s. and then decreased to 10 c.p.s. Any desired range within the total may be selected. Selector can be switched off and frequency held at any c.p.s.

Recommended for testing electronic, electrical, mechanical or optical parts. One of 7 models. Send for Catalog F, containing helpful data, nomograph chart and listing typical users. Write to

ALL AMERICAN TOOL & MFG. CO.

8019 LAWNDALE AVENUE, SKOKIE, ILLINOIS

Makers of All American Precision Die Filing Machines



# UPPER PENINSULA Power Link

## S-A CONVEYOR SYSTEM helps transform coal into low cost kilowatts!

Late in September 1955, the Upper Peninsula Generating Company, Marquette, Mich., turned on the power for full commercial use at their new Presque Isle station. This plant constitutes part of the first direct power link between the Keweenaw Peninsula copper mining area and the Marquette iron range.

Presque Isle's steam turbines are powered by coal, still the most economical fuel for power generation. From point of truck delivery at a hopper receiver station, coal is transported over an S-A belt conveyor, thru a crusher unit, and ultimately to silo storage by bucket conveyors. The entire operation is automatic.

In the power field where continuous, trouble-free and economical coal handling is vitally important, S-A equipment has compiled an enviable record. Our many years of experience in providing low cost per ton, high quality coal handling systems, is your assurance that it pays to convey the S-A way.

**Schematic drawing showing complete Stephens-Adamson conveyor installation at Presque Isle.**

S-A engineers work with consulting or staff engineers, with public utility or private power plant operations. We can assist the building contractor on new construction or can completely engineer and install your entire conveying system. Call S-A today. There is no obligation.

**STEPHENS-ADAMSON MFG. CO.**

**19 Ridgeway Avenue, Aurora, Ill.**

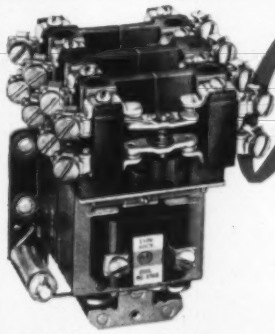
**Los Angeles, Calif. — Belleville, Ontario**

**ENGINEERING DIVISION**
Designers and manufacturers of all types of bulk materials conveying systems.

**STANDARD PRODUCTS DIVISION**
A complete line of conveyor accessories—centrifugal loaders—car pullers—bin level controls, etc.

**SEALMASTER DIVISION**
A full line of industrial ball bearing units available in both standard and special housings.

24" x 24" Double rotor knittel crusher reduces coal to 1½" to ¼" size in one operation. Rotors rotate toward each other to permit reduction of larger lumps, with smaller diameter rotors, lower headroom, elimination of plugging.

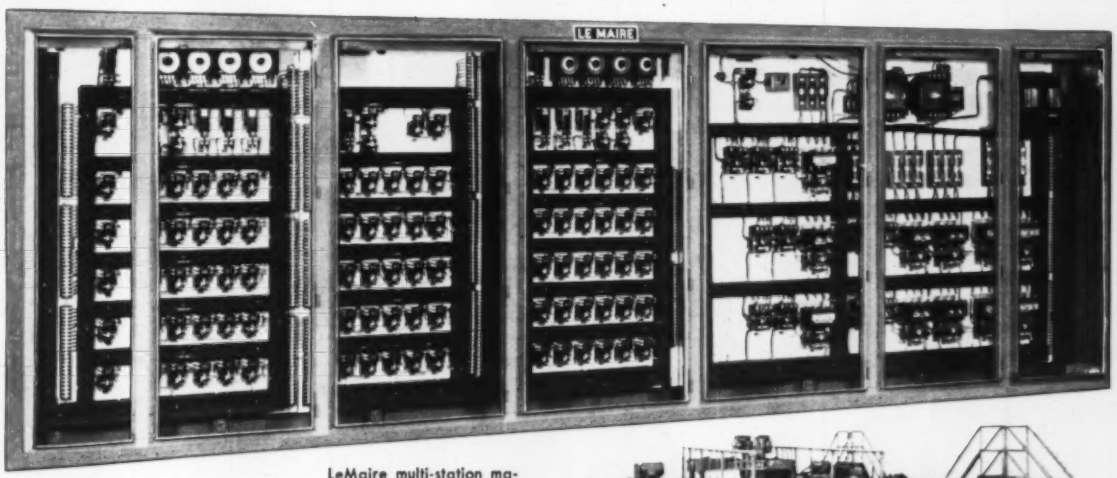


Bulletin 700 BX Universal relay with 4 normally open & normally closed contacts.

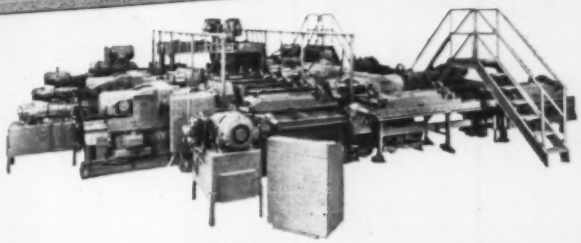
# OVER 125 ALLEN-BRADLEY

## RELAYS, TIMERS and STARTERS

### in this LEMAIRE Multiple Station Machine Panel




LeMaire multi-station machine operated by panelboard shown above. A good example of Allen-Bradley solenoid controls in the automotive industry.



Bulletin 709 Size 3 starter. Rated 30 hp, 220 v; 50 hp, 440-550 v.

Bulletin 709 Size 1 starter. Rated 5 hp, 220 v; 7½ hp, 440-550 v.

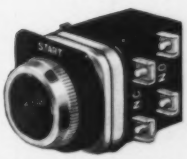
Bulletin 702 3-pole relay with magnetic holding latch. A hum-free relay.

Did you notice the prominence of Allen-Bradley solenoid motor controls at the recent Chicago Machine Tool Show? Manufacturers recognize these reasons . . . the long, trouble free life of Allen-Bradley motor controls . . . their unerring precision in operation . . . the inherent QUALITY of their workmanship and materials.

Machinery manufacturers look to Allen-Bradley as a reliable source of control units and components. The A-B trademark is to them and their customers The Sign of QUALITY in Motor Controls.

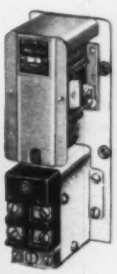
Send for the Allen-Bradley Handy Catalog. It is a recognized handbook on motor control. Or, let our control specialists help you with your control problems.

Allen-Bradley Co., 1316 S. Second St., Milwaukee 4, Wis.
In Canada—Allen-Bradley Canada Ltd., Galt, Ont.




Bulletin 800T oiltight push button with NO & NC contacts.

Bulletin 802T adjustable lever limit switch.



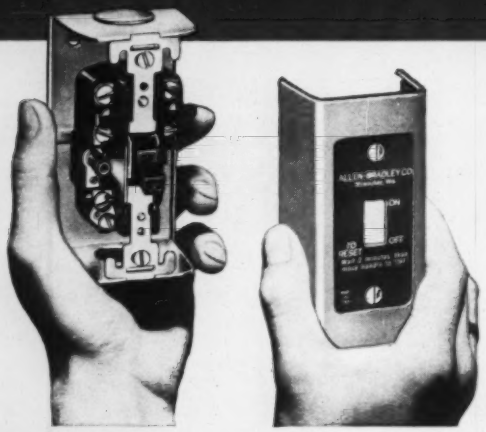
Bulletin 849 pneumatic timer—adjustable from 1/10 to 180 sec.

ALLEN-BRADLEY
QUALITY
TROUBLE FREE
MOTOR CONTROL

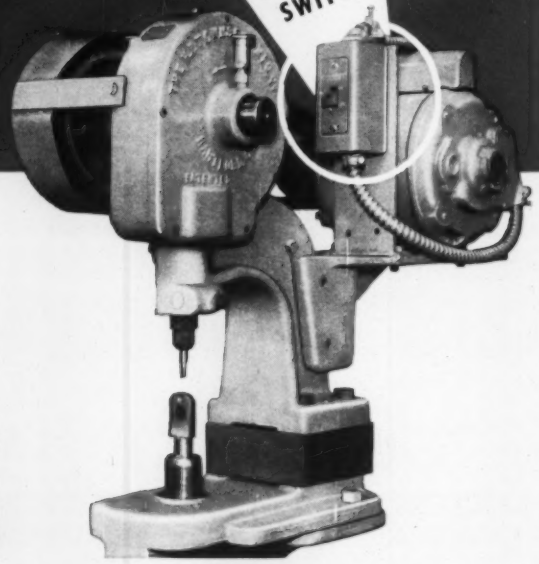
2-56-R

# SMALL MOTORS need overload protection too!

BULLETIN 600 STARTING SWITCH







## *Because*

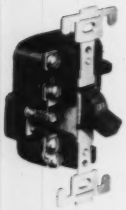
## SMALL MOTORS CAN BE AS IMPORTANT TO PRODUCTION SCHEDULES AS LARGE MOTORS

Here is an outstandingly popular starter for applications using motors of ONE HORSEPOWER OR LESS.

It is a small, manually operated starter that is equipped with a time-tested, reliable A-B overload breaker. A soldered ratchet trips the operating lever in case of a sustained overload. It is reset, after tripping, merely by moving the operating lever to the OFF position. Overload heater elements are available to cover the ratings of this starter.

The Bulletin 600 starting switch is available in single and double pole construction. Its double break, silver alloy contacts provide high interrupting capacity. The contacts are always in good operating condition. They never need to be cleaned, filed or dressed. Please write for a copy of Bulletin 600 for complete information on the Bulletin 600 line.

### SIMPLE DESIGN

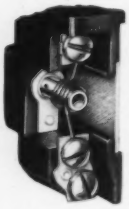


Simple ON & OFF snap switch . . . easy access to terminals . . . ample wiring space . . . silver alloy contacts need no cleaning or maintenance.

### ATTRACTIVE APPEARANCE

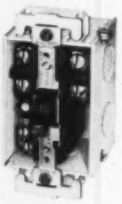
Streamlined enclosure in grey enamel, and bonderized to assure positive binding of enamel finish to resist corrosion. The pilot light is optional.

### OVERLOAD BREAKER



According to National Elec. Code ruling, motors of 1 hp or less, automatically started by thermostat, float switch, etc. must have overload protection.

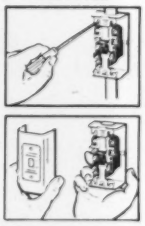
### FITS STANDARD SWITCH BOXES



Bulletin 600 starters fit any standard 2½ in. deep wall switch box.

Can be mounted in machine frame or base. Available with pilot light.

### EASY TO INSTALL

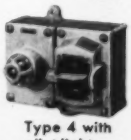


Remove 2 screws on front of starter . . . slip off cover . . . attach conduit . . . pull in wires and connect to terminals . . . replace the cover.

### VARIETY OF ENCLOSURES

Type 7 for hazardous locations.

Type 4 watertight.



Type 4 with pilot light.

Allen-Bradley Co.
1316 S. Second St.
Milwaukee 4, Wis.
In Canada—Allen-Bradley Canada Ltd., Galt, Ont.

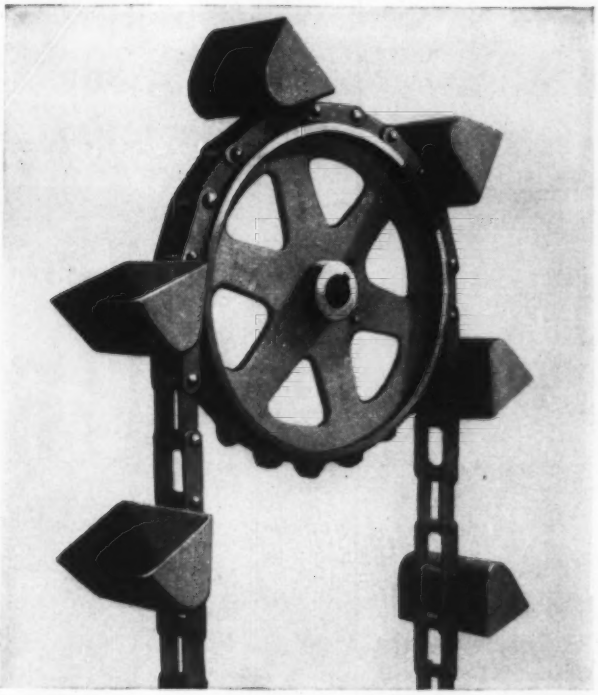
A-B Quality

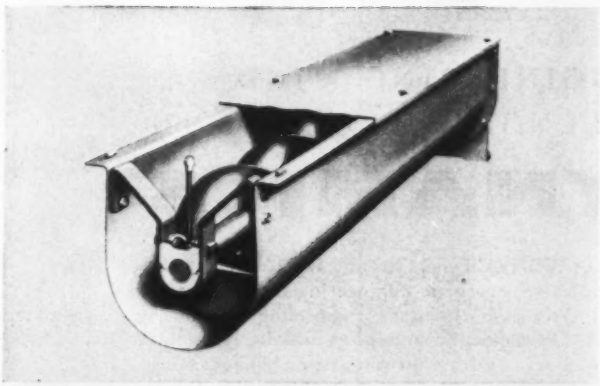
ALLEN-BRADLEY

BULLETIN 600 STARTING SWITCHES

QUALITY

2-56-MR





*take a tip from original equipment makers...*

# choose JEFFREY equipment for long life!

**Jeffrey combination chain** (pictured here) offers excellent wear-and-shock-resistance for drives of moderate speed and for gritty materials. All Jeffrey chain combines maximum strength with minimum weight, assuring long life and ability to withstand shocks and overloads.

Jeffrey's wide range of sprocket wheels meets most industrial requirements. Chainsaver sprockets add to the life of chains by distributing wear over wider areas. Jeffrey malleable iron buckets are smooth, seamless and strong, affording comparatively clean delivery of materials.

**Spiral conveyor** and fittings from the complete Jeffrey line meet practically any requirement. Modern manufacturing methods insure uniform strength and true alignment.

**Jeffrey vibrating feeders** and conveyors control the movement of large or small tonnages accurately and economically. They are designed to give dependable, around-the-clock operation, often working under extremely adverse conditions.

You'll also find Jeffrey products on your mixers, dredges, power shovels, ditchers, loaders and other machines, put there by manufacturers who recognize Jeffrey's high quality. Replace worn parts with the same dependable Jeffrey equipment. The Jeffrey Manufacturing Company, Columbus 16, Ohio.

JEFFREY

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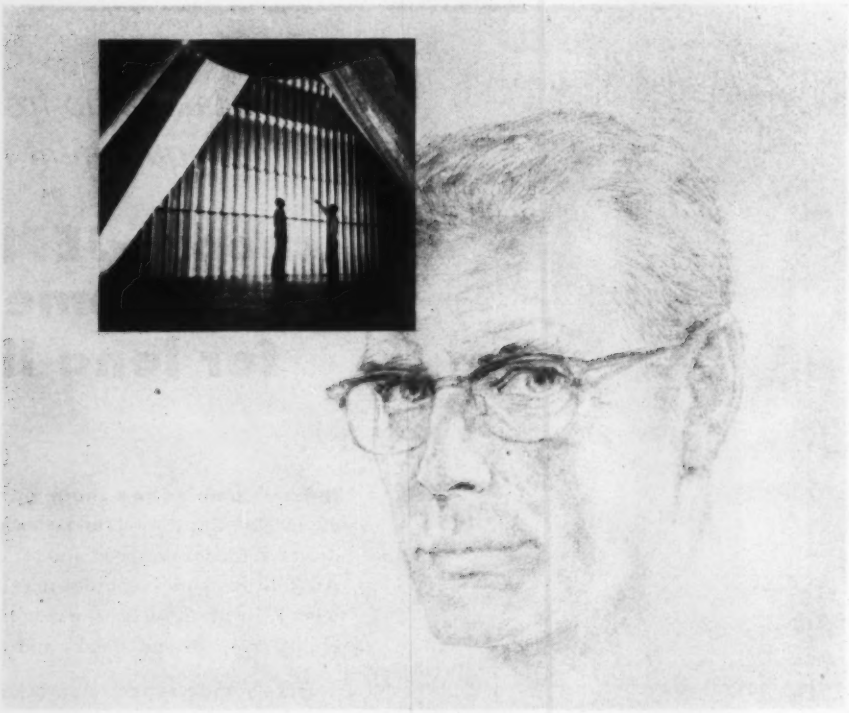

TO THE FINE ENGINEERING MIND
SEEKING THE CHALLENGING PROJECTS IN

# AERODYNAMICS

**AERODYNAMIC ENGINEERS AND SCIENTISTS** are urgently needed now at Convair in beautiful, sunny San Diego, California. Excellent career opportunities exist for junior and senior engineers for aerodynamics, performance and heat transfer analyses related to advanced projects in the supersonic Mach number range. A balanced background in experimental and theoretical aerodynamics is ideal for these positions. Analytical aerodynamic studies using analogue and digital computers are an integral part of this work. Challenging positions are also available for aerodynamicists experienced in research and development wind tunnel and firing range tests.

**CONVAIR** offers you an imaginative, explorative, energetic engineering department . . . truly the "engineer's" engineering department to challenge your mind, your skills, your abilities in solving the complex problems of vital, new, long-range programs. You will find salaries, facilities, engineering policies, educational opportunities and personal advantages excellent.

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# CONVAIR

*A Division of General Dynamics Corporation*

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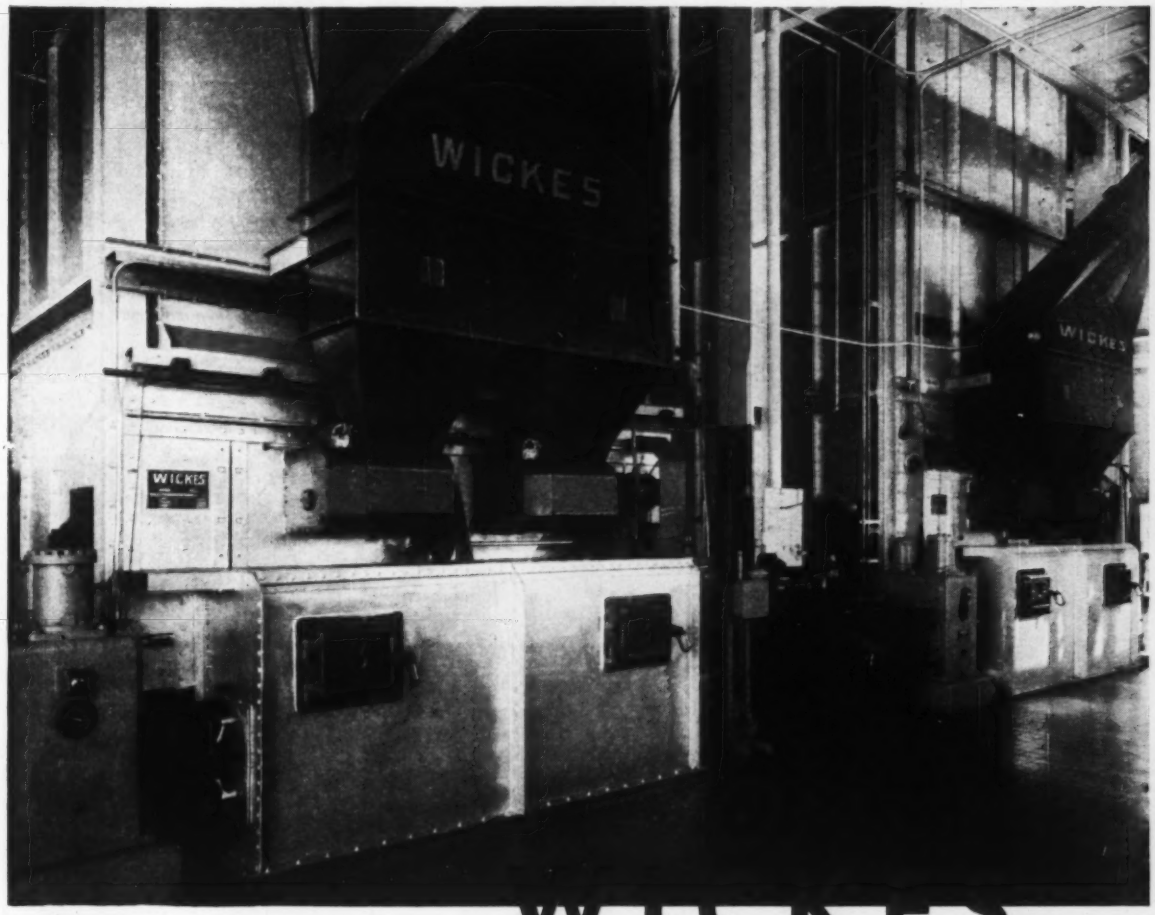
## Wickes Boilers selected by one of America's newest, most up-to-the-minute automotive parts and accessories plants




WICKES

**These two Wickes steam generators were installed recently in one of America's most modern automotive parts plants. Each delivers 66,000 lbs. of steam per hour, has a boiler and water wall heating surface of 7340 sq. ft. and an air pre-heater of 5225 sq. ft. Design pressure is 200 psi, operating pressure 150 psi, and water feed temperature 225°F. In factories, institutions, municipal buildings, refineries, processing plants, and many other installations throughout the country, Wickes boilers are supplying dependable, low-cost heat and power. Wickes builds water tube steam generators in a great variety of types and sizes to fill the individual needs of any application. If you are building new facilities, or wish to replace your present steam generator with a newer, more efficient one, contact Wickes. We will be pleased to send you our new 24 page bulletin No. 55-1 containing complete information on Wickes steam generators and fabrication facilities.**

# THE WICKES BOILER CO.

**DIVISION OF THE WICKES CORPORATION • SAGINAW, MICHIGAN**

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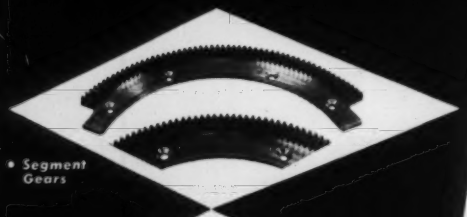
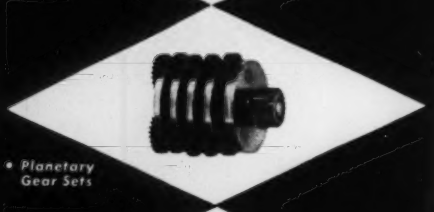
160

Vard maintains a complete gear facility. Vard designs and fabricates gears and gear assemblies to aircraft quality standards in custom or production quantities.

# Gears

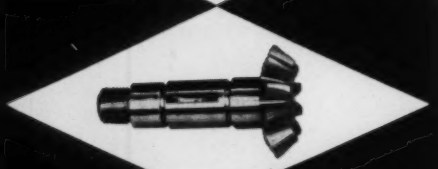


- Segment Gears

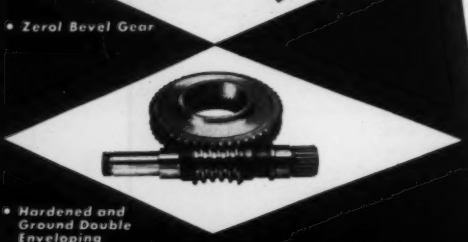


- Planetary Gear Sets

- Constant Acceleration Gears

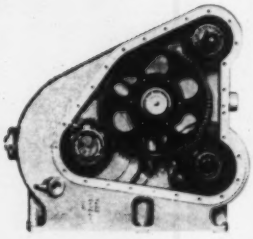


- Zerol Bevel Gear

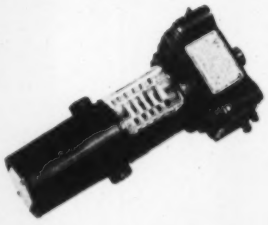


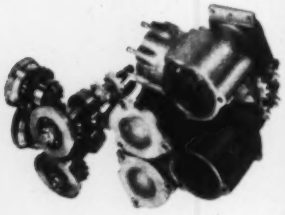
- Hardened and Ground Double Enveloping Worms and Worm Gears

*Alternator — Generator drive gear box manufactured by Vard. Rated at 100 hp at 4000 rpm.*

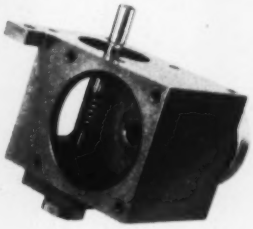


*Rotary Actuator developed by Vard. Employs a 6 stage planetary gear system to obtain a reduction of 15,200 to 1.*





*Gear Train unit which employs a worm gear and mitre bevel gears.*



*Double Enveloping Worm Gear Box which utilizes a worm that is ground after the hardening process (Rc 60) resulting in zero backlash.*

Write for Vard Hardened and Ground Double Enveloping Worm and Worm Gear brochure . . . Bulletin #1002. Also available is the Vard Custom Products brochure . . . Bulletin #1003.

Resident Sales Engineers:
New York City • Dayton, Ohio
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**FIRST . . . in custom gearing**

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# LOEWY

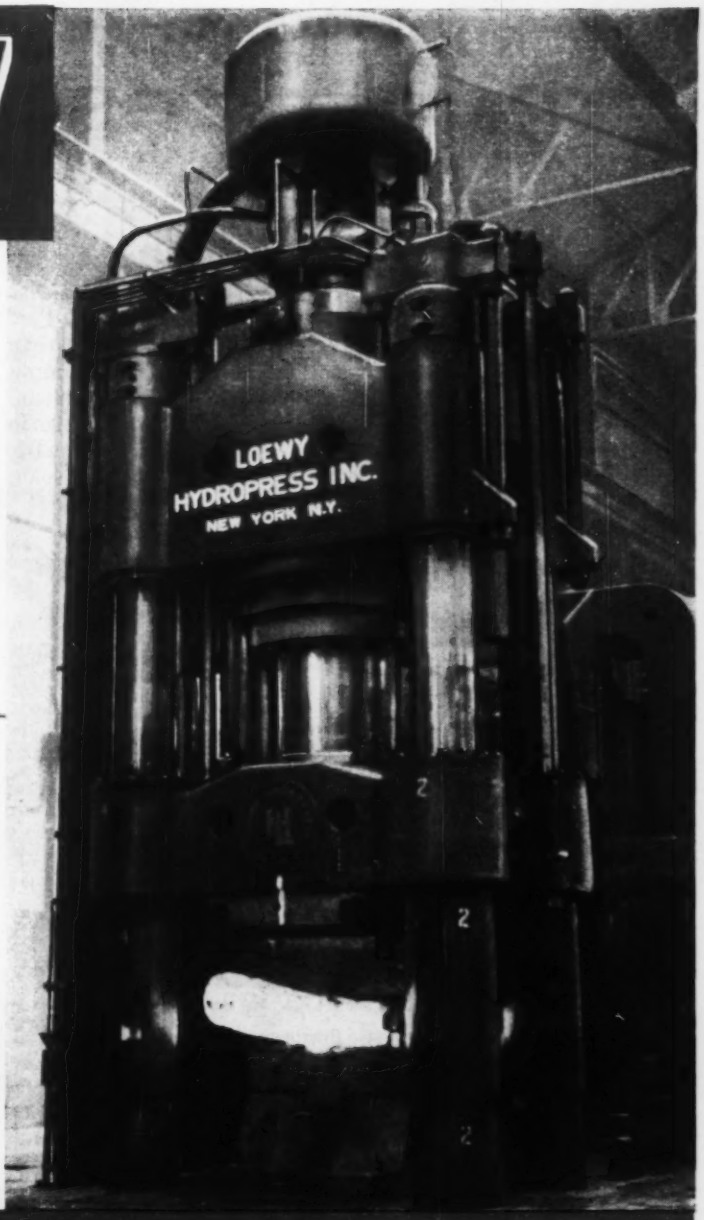
## *High Speed*

## FORGING PRESSES

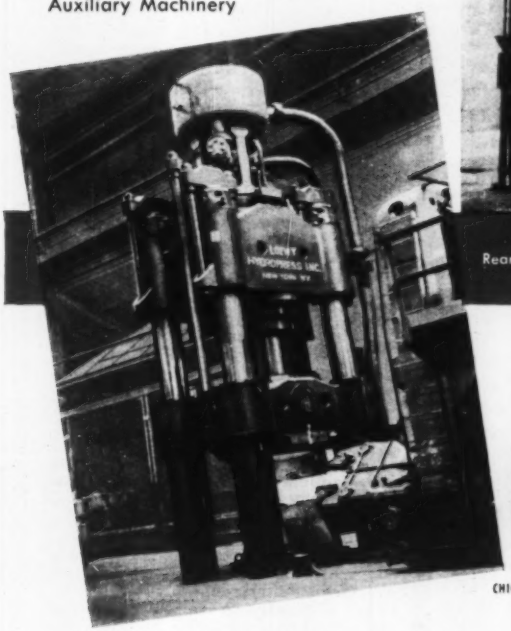
**are replacing hammers to forge blooms in specialty alloy steels WITH FEWER REHEATS**

***Loewy Hydraulic Presses for the steel and non-ferrous industries***

- Forging and Die Forging Plants
- Deep Drawing Single and Double Acting Presses
- Extrusion Plants for Steel and Non-Ferrous Metals
- Hot and Cold Rolling Mills and Auxiliary Machinery




High-speed forging press of 2,000 ton capacity



Rear view with manipulator.

**LOEWY HYDROPRESS INCORPORATED**

ENGINEERING • CONTRACTING

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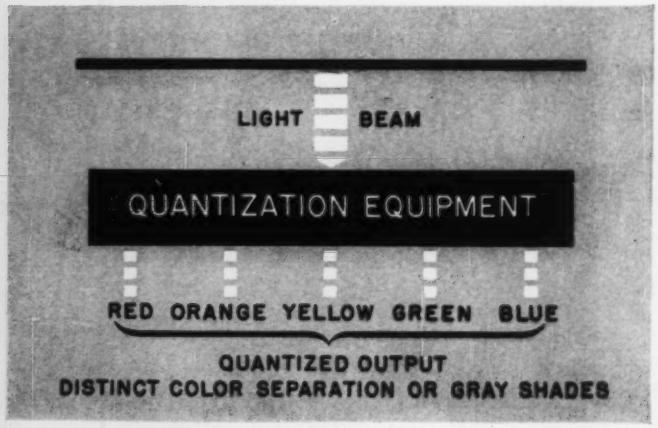
# FORD INSTRUMENT QUANTIZES LIGHT

Colored lines or spots on a piece of paper can become a means of conveying information – Rorschach charts, impressionist paintings and survey maps are all visual message carriers. Ford Instrument engineers found it necessary to translate such color information into electrical or mechanical quantities, (quantization) with less distortion than is inherent in the usual photographic techniques. Such quantities can in turn be used as signals that actuate computers, make offset plates, and generally put to use the information implied by the difference between the colors or the distribution of the colors.




The quantization performed by Ford is not restricted to color alone. For example, a black and white photograph represents an aggregate of light and dark areas of varying shades, and this display must frequently be converted into continuous or discrete electrical quantities for various purposes and uses. Ford engineers recently developed equipment which can quantize and record the various degrees of color, or gray areas in photographic negatives, and to correlate this information into usable data. This equipment was developed for a classified project – the equipment is unavailable for general use – however the technical know-how gained by Ford – combined with Ford's superior production and engineering facilities – is available in the creation of light quantizing equipment for you.

Light quantizing is but one of the many facets of Ford Instrument design and development. For more information about Ford's products, services and facilities, write for an illustrated folder. Ford engineers will be happy to discuss your problems of control with you.

88

**FORD INSTRUMENT COMPANY**
DIVISION OF SPERRY RAND CORPORATION
31-10 Thomson Avenue, Long Island City 1, New York
Beverly Hills, Cal. • Dayton, Ohio

## Ford's capabilities are among the finest in the country

**Three dimensional cams** are used in elaborate computing devices to characterize shell ballistics, magnetic variation, or to solve some basic mathematical function. Precision in 3-D cams is of vital importance. Ford Instrument designed and built a unique machine that can produce extremely accurate cams from a skillfully made master. As many as two thousand data points are end-milled to set precisely the contours of the handcut masters.

**Equipment used for defense** must undergo rigorous tests for accuracy and dependability in combat. At Ford, environmental testing laboratories reproduce extremes of desert or arctic battle, shock of warship broadside, salt fogs and heavy seas. When flaws have been detected and corrected, equipment is okayed for volume production and use throughout the armed services.

**Typical of Ford Instrument's 40 years of experience** in precision control is its work in the field of nuclear power. The Company, for example, is building the control rod drive mechanism for the Seawolf, second atomic submarine. Reactor designs, sensing mechanisms, control equipment and systems, nuclear calculations, and other specialized equipment and abilities are offered by the Company to this expanding industry.

*A Timely Word to Drafting Department Heads...*

# NOW* Is the Time to Get Your New Modern Bruning Copyflex Machine!

* **Because you'll need greater print-making capacity to meet the push for more drafting room output!**

* **Because your old reproduction unit can't keep pace with increased demands!**

* **Because, with management's desire for greater production, you can justifiably include new equipment in your capital expenditure program.**

**NEW COPYFLEX MODEL 500**

A new, ultra-fast, heavy-volume machine offering top mechanical speed of 40 f. p. m., automatic separation, front or rear delivery, automatic stacking, and a host of other advanced features.

**You Need It!** The boom in production means more pressure than ever for engineering prints. Modern Copyflex will help you deliver them! New, better-than-ever models bring you faster reproduction speed and a host of operator conveniences to step up production.

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**You Can Get It!** Chances are that your firm, like most others, is gearing up for greater-than-ever production. You couldn't pick a better time to include new, higher-production equipment in your program. There's a new, improved Copyflex model to suit every price and production requirement. Mail coupon today. You'll be glad you did!

**Three Other New, Improved Copyflex Models**

**Model 250.** Newest and finest of its size. Takes less than a sq. yd. of floor space. Up to 25 f.p.m. speed —18½" printing width. Automatic stacking and separation.

**Model 35.** Provides up to 30 f. p. m mechanical speed and a full 46-inch printing width for heavy volume reproduction — at a thrifty, low price.

**Model 100.** The helper your big machine needs. Makes up to 300 prints of one or many different 8½" x 11" originals per hour—at less than 1¢ each for materials.

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Please send me information on Copyflex process and____Model 500 ____Model 250____Model 35____Model 100.

Name_____ Title_____

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# DETROIT ROTOSTOKERS

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***Fire The Boilers In***

***The New Prudential Mid-America***

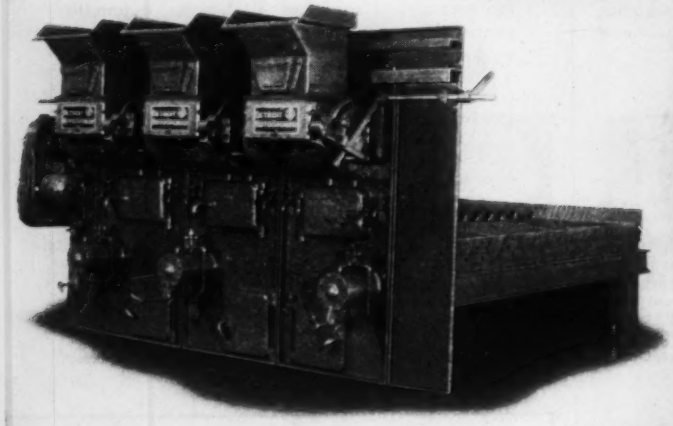
***Home Office Building—Chicago***

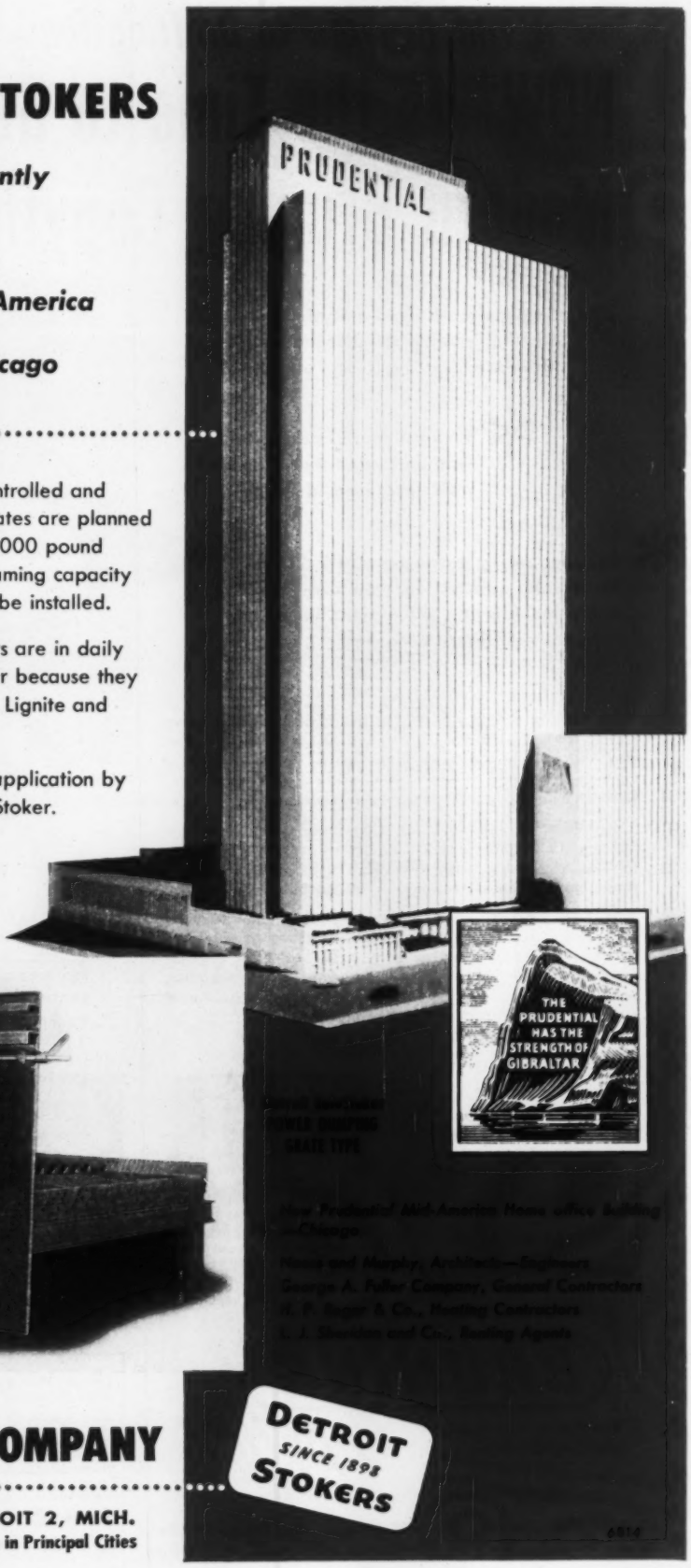
Detroit RotoStokers, automatically controlled and having Power Operated dumping grates are planned to burn southern Illinois coal. Two 40,000 pound and one 22,000 pound per hour steaming capacity Erie City Steam generating units will be installed.

Many hundreds of Detroit RotoStokers are in daily operation in prominent plants. Popular because they successfully burn all Bituminous Coals, Lignite and also wood and other refuse fuels.

Buy a stoker for proper design and application by experienced builders. Buy a Detroit Stoker.

*Write for a catalog. No obligation.*



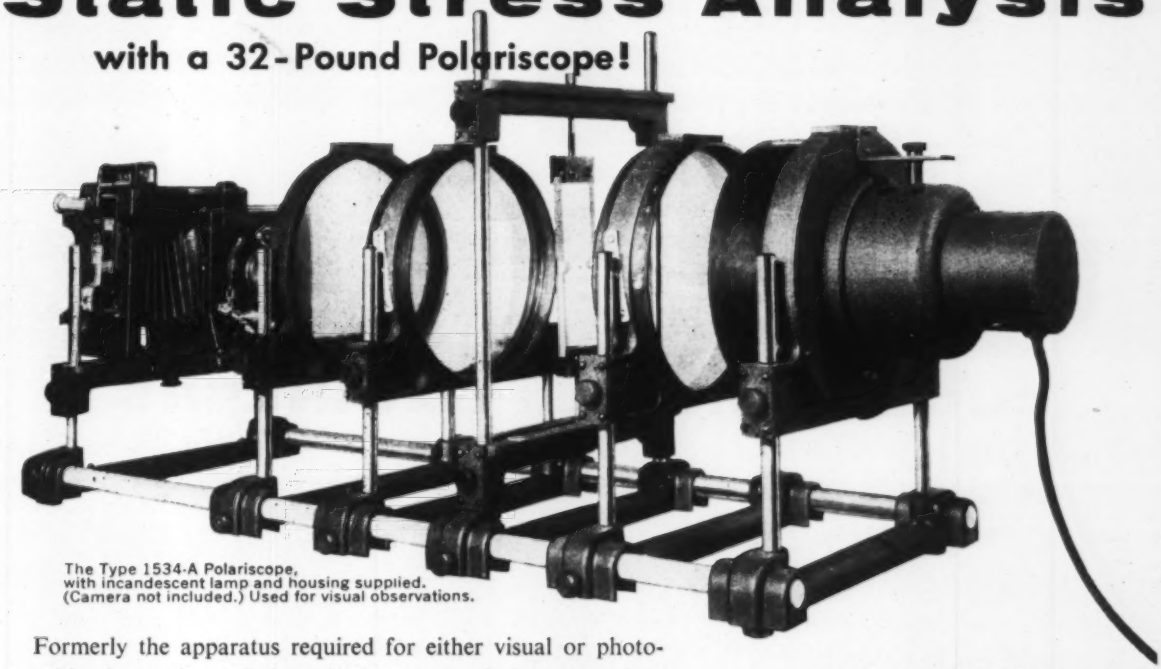



# DETROIT STOKER COMPANY

**GENERAL MOTORS BLDG., DETROIT 2, MICH.**
**Works at Monroe, Mich. • District Offices in Principal Cities**

# Dynamic or Static Stress Analysis

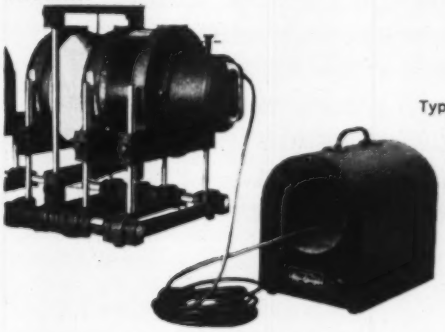
## with a 32-Pound Polariscope!



The Type 1534-A Polariscope, with incandescent lamp and housing supplied. (Camera not included.) Used for visual observations.

Formerly the apparatus required for either visual or photographic observations of photoelastic stress analysis was cumbersome, very expensive, excessively bulky and heavy, and required permanent installation.

The G-R Polariscope is a unique solution to the problem. With its auxiliary STROBOLUME high-intensity stroboscopic light source, the exposure time is reduced to 40 microseconds instead of the usual several minutes required with conventional polariscopes. The effects of any external vibration are completely masked by this extremely short exposure. The polariscope can then consist of an assembly of light rods, supports and disc mounts.



Type 1532-B Strobolume in place, with its power supply at right. Forty microsecond flash duration provides ample illumination for use with any camera with an f/4.5 lens.

### The Type 1534-A Polariscope has a number of unusual features:

★ Unusually large field of eight inches . . . allows use of models large enough for easy fabrication and handling . . . permits more detailed analysis than is possible with small models

★ Very simple means for making instantaneous photographs of dynamic stresses . . . any standard camera with a lens as fast as f/4.5 is suitable.

★ Compact enough to mount directly on the bed of many standard testing machines

★ Portable and readily put together or taken apart . . . will fit in any compact carrying case . . . ideal for lectures and other demonstrations

★ Flexible design makes changing from plane to circular polarization very simple . . . easily removed quarter plates and polarizers

★ Much simpler than an optical bench . . . wide range of vertical and horizontal adjustments

★ LOW COST: $490.00 with incandescent illumination for visual observations. Auxiliary high-speed STROBOLUME (1/25,000 second flash) for photographic studies: $265.00

Write for the POLARISCOPE BULLETIN

**General Radio Company**

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1000 N. Seward St. LOS ANGELES 38

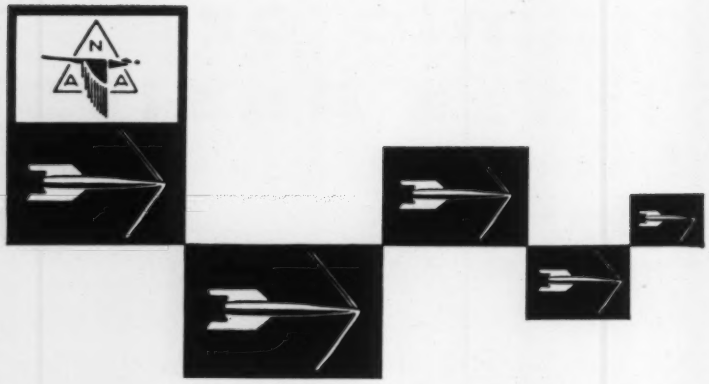
Please send a copy of your POLARISCOPE BULLETIN

Name ..... (610)

Company .....

Street .....

City ..... Zone ..... State .....



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# NORTH AMERICAN AVIATION, INC.

before after

# Modern Dravo heating saves this plant $6732 per year, frees 3400 sq. ft. of floor space

Sharp increases in heating costs traveled hand-in-hand with growth and expansion at Ideal Electric and Manufacturing Company's Mansfield, Ohio plant.

As manufacturing additions went on over the years, more and more hand-fired coal stoves were employed to heat new areas. Until recently, heating for the seven-acre plant area was handled by thirty-two such units. Heating problems never seemed to cease. With the lack of uniformity in heating, workers either froze or baked. Coal and labor costs (it took almost the full time of 5 men to fire stoves around the clock) never stopped climbing. Stoves and their bins gobbled up more than 4000 square feet of plant space!

When modern Dravo gas-fired, forced-air space heaters were installed, these problems disappeared, and the savings were immediate and substantial. Since eleven Dravo "Counterflo" heaters provided comfortable heat everywhere in the plant areas, 3600 square feet of valuable space was released ("Counterflo" heaters required only 600 square feet). But, more important was the actual gross savings of $6732 made possible last winter, '54-'55, through the use of these Dravo Heaters. When amortizing this new and standby equipment over a 10 year period, a net savings of $2735 per year is realized!

Remarkable? Then you will want to see for yourself what unusual cost-savings and heating efficiency Dravo heaters can bring to your heating systems. Use the coupon below to get complete details. You'll find it always pays to investigate Dravo Heaters!

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# How perfectly simple —this Fast's Coupling with purely mechanical flexibility!

1. A hub is keyed on each shaft. Hubs are splined at maximum distance from shaft ends.
2. Floating sleeves surround hubs. Sleeves are splined to engage hub splines.
3. Sleeves compensate for shaft misalignment by assuming neutral position between two hubs.
4. Because of distance from shaft end, any misalignment between splines is mere fraction of same misalignment between shafts.
5. Sleeves carried on bearing rings, located on transverse center line of hub spline faces (the load-carrying surfaces) — no crank action, no vibration.
6. Lubricant is centrifugally forced into spaces between engaged splines, forming a film.

For 35 years the most positive, dependable means of coupling machines to their power source . . . Fast's Couplings have no parts subject to repeated bending, tension or compression. Because there is no metal-to-metal contact, *there is no wear*—in fact, many Fast's Couplings in use for over 30 years show no signs of wear when disassembled! No leather, plastic or rubber oil seals. Lubricant film distributes pressure over a considerable area, diminishing localized stress at pressure points on the load-carrying teeth. Perfectly simple? Yes . . . and foolproof!

**For coupling catalog,** technical advice or assistance from Koppers field engineers, write: KOPPERS COMPANY, INC., *Fast's Coupling Dept.,* 3402 Scott Street, Baltimore 3, Maryland.

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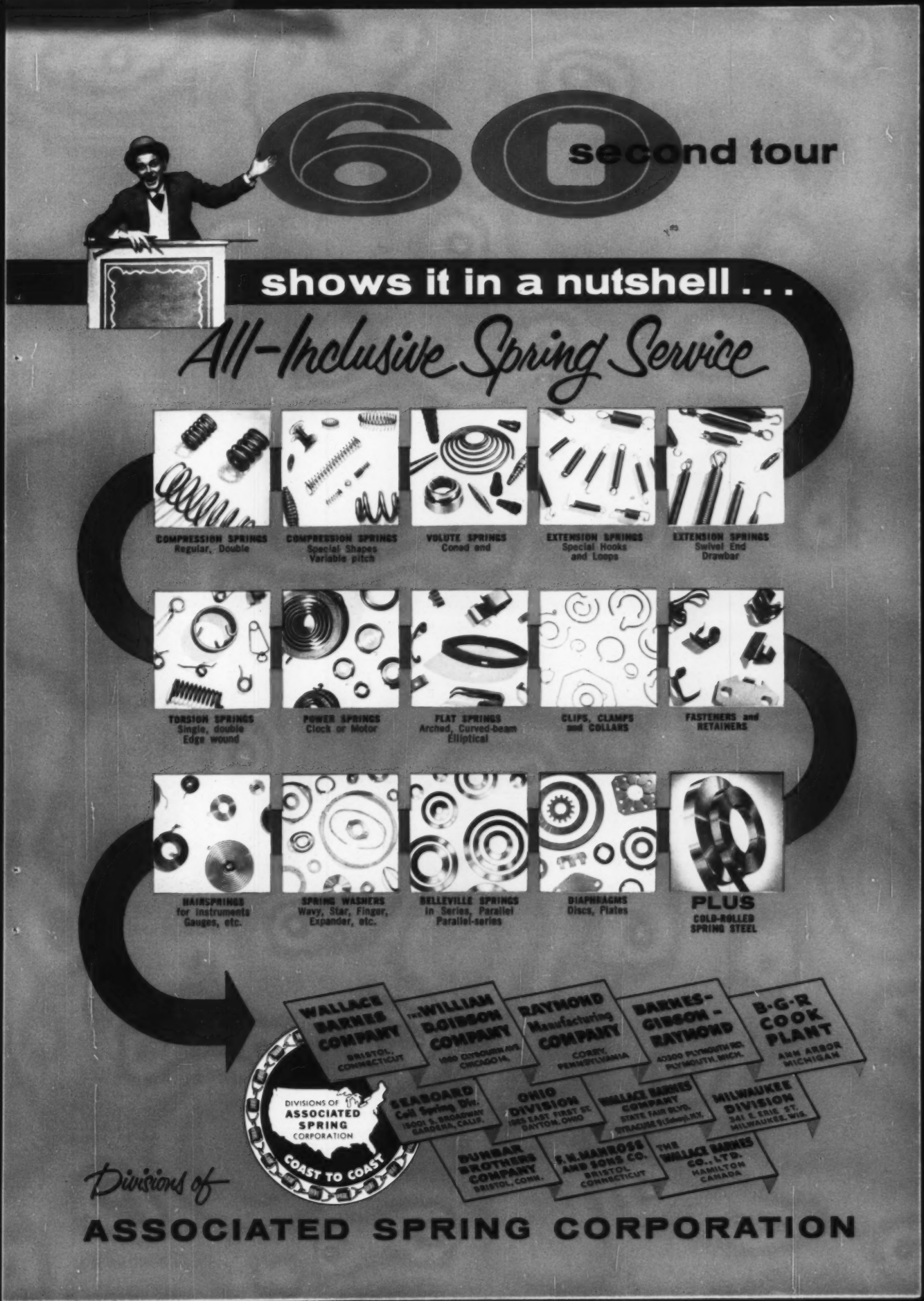
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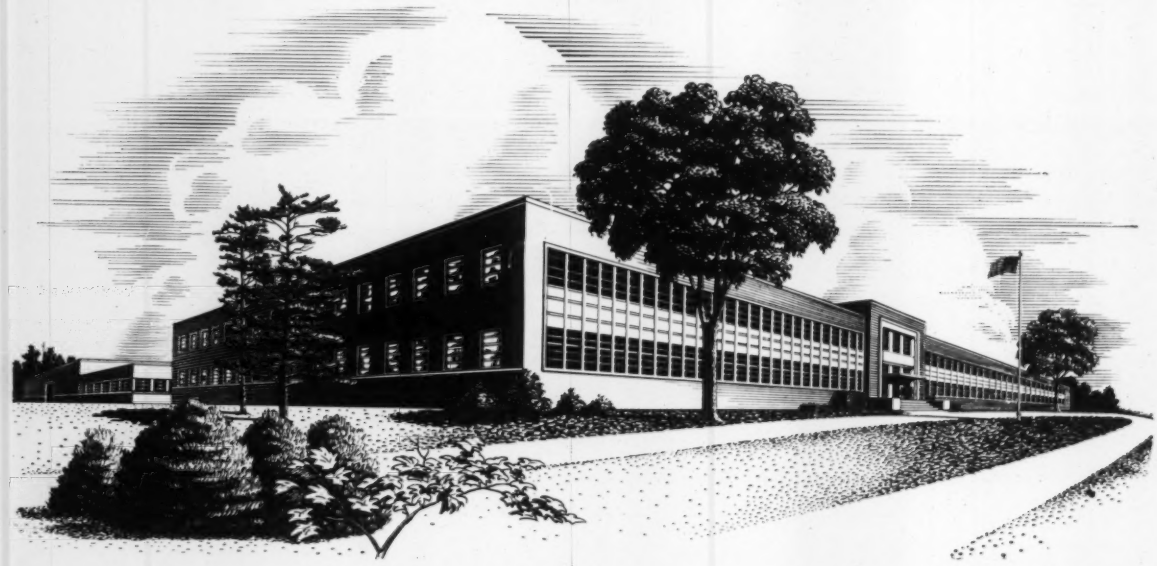

# COMBUSTION ENGINEERING now building

## NUCLEAR ENGINEERING AND DEVELOPMENT CENTER

On a 530-acre site in Windsor, Connecticut, Combustion Engineering is now building a Nuclear Engineering and Development Center. In addition to the Engineering and Administration Building, shown above, there will be a critical experiment facility for studying the physics and nuclear characteristics of reactor cores, a "hot" laboratory and a fuel element fabrication plant, together with related metallurgical, chemical and physical testing laboratories.

This multi-million dollar project, for which Stone & Webster Engineering Corporation are the architects and engineers, is scheduled for initial operation late this year and completion in early '57. In conjunction with new nuclear facilities recently placed in operation at the Company's Chattanooga, Tenn., plant, the Windsor plant will enable Combustion

**to design, develop and manufacture complete nuclear power reactor systems**

Heavy components such as reactor vessels, boilers, plugs and shields will be manufactured at Chattanooga. Reactor cores, including fuel elements and control rods, will be produced at Windsor.

The new nuclear building at Chattanooga includes such equipment as a 15,000,000-volt betatron for fast X-raying of thick plate and welds; large precision machine tools capable of handling work up to 20 feet in diameter with accuracies comparable to those required in watchmaking; and cranes to handle loads in excess of 300 tons. A new dock is equipped to handle reactor vessels too large and heavy for rail or highway shipment. By virtue of these facilities, Combustion becomes the *first company in the world* to possess equipment especially designed for the manufacture of heavy reactor components and to be able to ship them by water to virtually all river and coastal ports.

The panel at the right reveals the Company's current activity in the nuclear field. With the new facilities now available or in process, and others recently authorized, Combustion is prepared to achieve the same position of leadership in nuclear power that it has long occupied in the field of conventional power generation.

## C-E NUCLEAR WORK 1955-56

Contract to design, develop and build complete nuclear reactor system for a submarine. *(This contract made Combustion the country's third major contractor to AEC on the naval reactor development program, and the first to undertake such a contract with its own facilities.)*

Contract to design and build major reactor components for U.S.S. Seawolf.

Contract to design and build major reactor components for large naval surface ship.

Contract to design and build major reactor components for Submarine Advanced Reactor and Submarine Fleet Reactor Systems.

Contract to design and build major reactor components for Shippingport plant to be operated by Duquesne Light Company. *(This will be country's first commercial size nuclear power plant.)*

Contract to design and build major reactor components for Atomic Power Development Associates. *(This fast breeder reactor, to be operated by Detroit Edison Company, is regarded as the most advanced type projected to date for a commercial size power installation.)*

Agreement with AEC for design and evaluation studies of both large and small reactors and of fuel elements and their fabrication.

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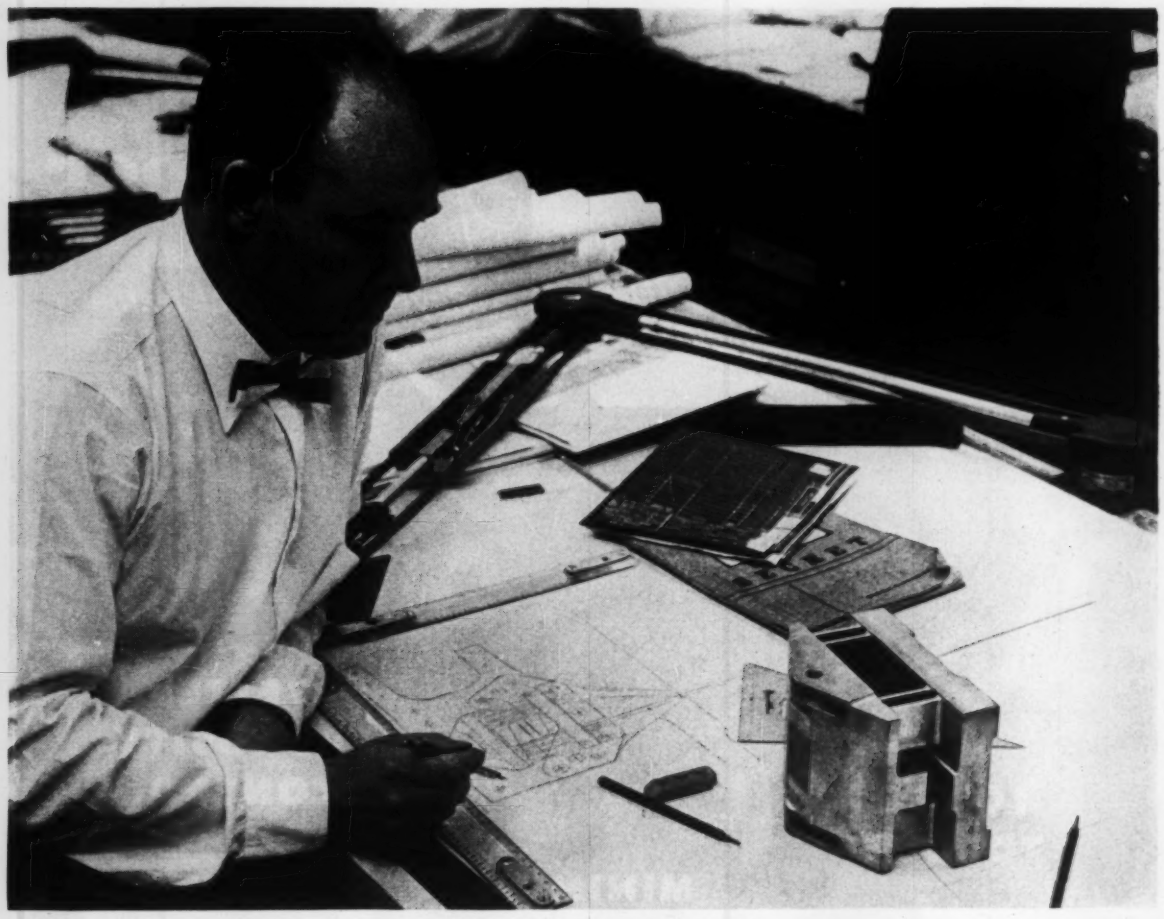

# Thrust gage design is this Boeing engineer's "baby"

From layout to missile firing, this project is a Boeing engineer's responsibility. His assignment: to design an engine mount that will isolate from other loads and measure within ½ of 1% accuracy the tremendous in-flight thrust of a guided missile.

The mount, called a thrust gage, must fit engine and airframe without modification of them, and must "grow" equally in all directions during a temperature rise of several hundred degrees in less than a minute. The object: a stronger mount weighing less than half the present one.

This is typical of the challenging and creative assignments given Boeing mechanical engineers. There are 1,800 of them. And more are needed for years-ahead projects in structural and flight testing, thermo and fluid dynamics, stress analysis, mechanisms design, etc.

This engineer is finishing his layout, with the preliminary mockup before him. Next, he will supervise draftsmen and engineering aides in final drawings. Then he will work closely with other engineers in production, structural testing, instrumentation and telemetering. Creating this thrust gage gives him responsibility, career growth, and a real sense of professional achievement.

Boeing engineers have career stability in a soundly growing company that now employs more than twice as many engineers than at the peak of World War II. Living is pleasant for them in the progressive, comfortable-size communities of Seattle and Wichita.

These men take satisfaction in knowing they're on a winning team that has created such aviation milestones as the new 707 jet tanker-transport, the giant B-52, and the Boeing B-47, "backbone" of Strategic Air Command. There's a rewarding job awaiting you now at Boeing in design, research or production.

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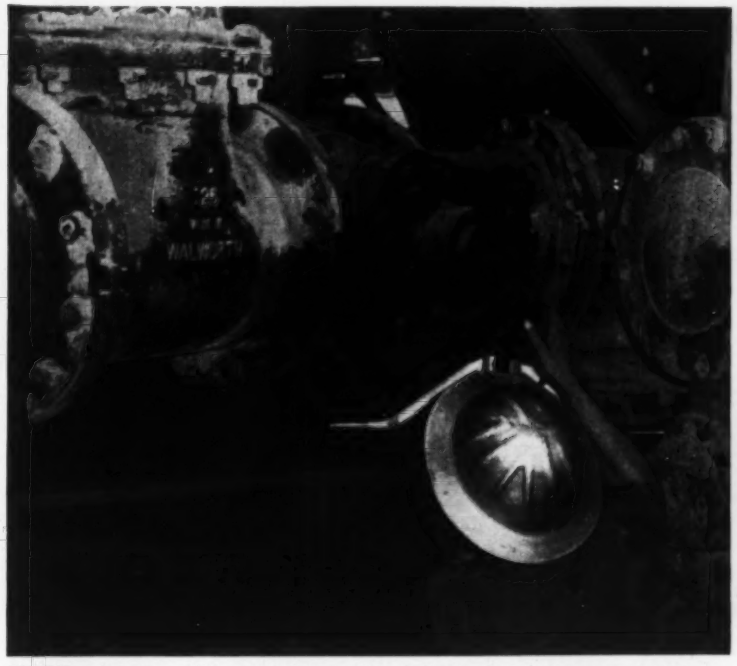


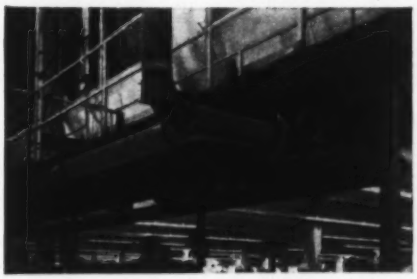
**CEMENT:** Lubricating a Walworth Lubricated Plug Valve in a West Coast cement plant.

**BEVERAGE:** A battery of Walworth Bronze Lubricated Plug Valves installed in the blending department of a distillery.

**PAINT:** Eighteen Walworth Lubricated Plug Valves in a common manifold installation in the varnish division of a midwestern paint and varnish works.

*serving almost any industry you can name . . .*

# WALWORTH LUBRICATED PLUG VALVES



**FOOD:** Walworth Lubricated Plug Valves are included in the piping arrangement in this large midwestern bakery.

**PUBLIC UTILITY:** Straight-way and three-way Walworth Lubricated Plug Valves installed in a modern West Coast sewage disposal plant.

At one time Walworth Lubricated Plug Valves were considered a "specialty item". Here are some of the features that have led to their employment in a wide range of industries as high quality 'all-purpose' valves:

(1) There are no threaded stems or complicated seating mechanisms. (2) Because the plug is always seated in the body, solid matter, which might be in the line contents, cannot wedge between the seating surfaces and prevent a tight closure. (3) The position of the wrench handle, or the marking on the plug shank, or the stop collar, clearly indicate the position of the plug. The operator can see from a considerable distance whether the valve is open or closed. (4) Quick opening and closing of the valve is assured by only a quarter turn of the plug. (5) Lubricant can be renewed while the valve is in service.

Walworth manufactures complete lines of Lubricated Plug Valves in a variety of types and materials for working pressures up to 5000 psi and for vacuum services. Sizes range from ½ to 30 inches.

See your Walworth Distributor or write to Walworth for complete information.

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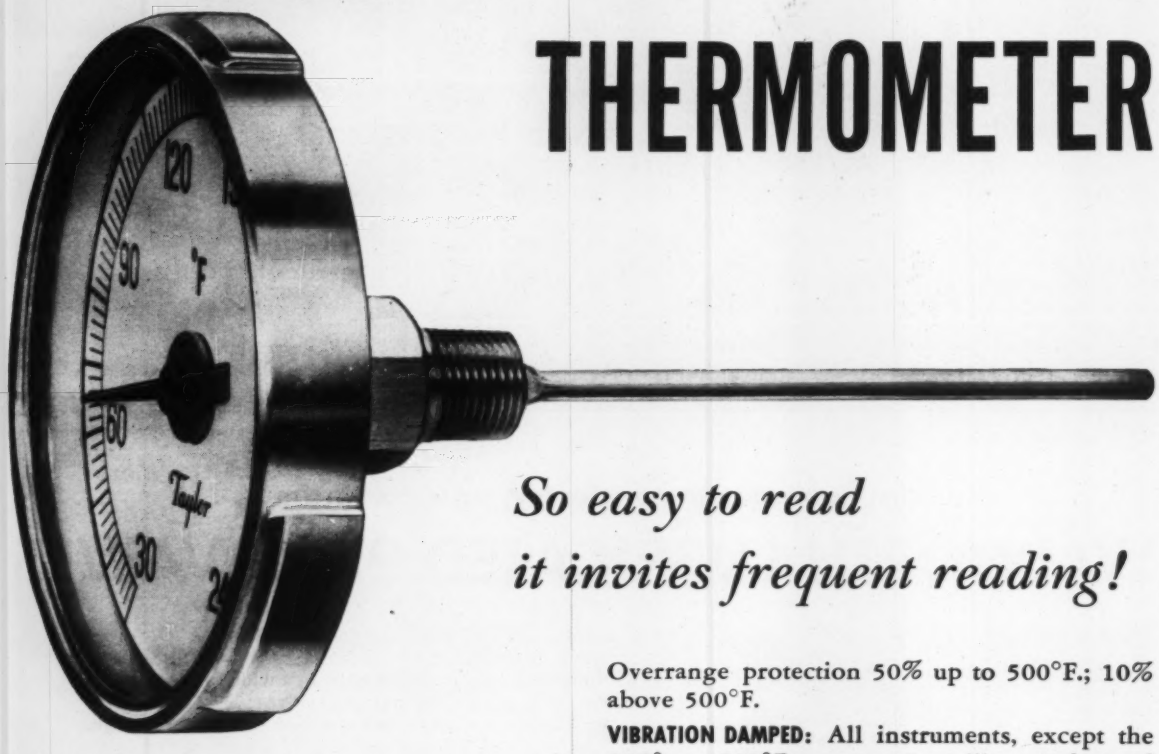


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*it invites frequent reading!*

A SIMPLE, dependable and economical thermometer with many applications throughout industry. Wide variety of ranges from minus 40° to +750°F. Also available with three inch dial; stem lengths of 4, 6, 9, and 12 inches; separable wells of brass, steel, type 304 stainless steel or monel.

**EASY TO READ:** The large dials are highly readable because of black figures and graduations on an aluminum background.

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**VIBRATION DAMPED:** All instruments, except the 200° to 750°F. range, are silicone damped against vibrations. Result is increased speed of response, minimum pointer vibration, and elimination of pointer chatter when the thermometer is handled.

**ECONOMICAL:** Costs only **$16** to **$26,** depending on dial size and length of stem. Ask your Taylor Field Engineer, or write for **Bulletin 98267.** Taylor Instrument Companies, Rochester, N. Y., or Toronto, Canada.

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- Flexibility Analysis by Model Test
- Approaches for Reducing Expansion Effects: Expansion Joints
- Supporting, Restraining, and Bracing the Piping System
- Vibration Prevention and Control
- History and Derivation of Piping Flexibility Analysis
- Derivation of Acoustic Vibration Formulas
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# M. W. KELLOGG'S DESIGN EXPERIENCE KEEPS PACE

As temperatures and pressures increase in steam-electric power plants, the problems involved in designing, engineering, and fabricating main and reheat steam piping multiply themselves many times over. This emphasizes, more than ever, the value of the long experience, in the laboratory and on the job, of The M. W. Kellogg Company—leader in the power piping field.

More evidence of M. W. Kellogg's accumulated piping design experience and ability to tackle each new power piping project in its stride, is the company's new 400-page book, "Design of Piping Systems"—published early this year by John Wiley & Sons. The most comprehensive work ever made available publicly on the physical design of piping, it is one of the many ways M. W. Kellogg cooperates with consulting engineers, engineers of power generating companies, and manufacturers of boilers, turbines, and allied equipment. An outline of contents is shown above.

**FABRICATED PRODUCTS DIVISION**
**THE M. W. KELLOGG COMPANY, 225 BROADWAY, NEW YORK 7, N. Y.**
*The Canadian Kellogg Company, Ltd., Toronto • Kellogg International Corporation, London*
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You can be sure of getting your copy of this limited edition of "Design of Piping Systems" by writing now to M. W. Kellogg, asking to be notified as soon as the book is available. Ask also for the new, free, 12-page booklet, "Piping Flexibility Analysis," which shows how M. W. Kellogg's various flexibility analyses techniques can cut piping design and construction costs.

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**Henry Vogt Machine Co., Louisville, Ky.**

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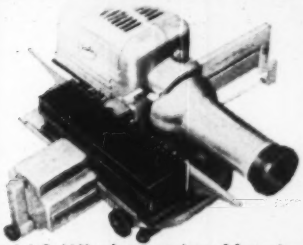
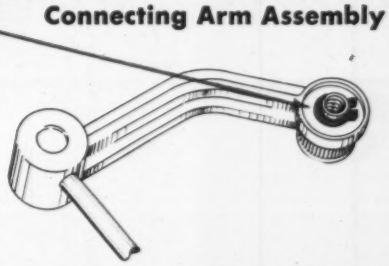
# Waldes Truarc Rings Permit Better and More Economical Design—Fewer Parts, Faster Assembly, Minimal Rejects!

### Viewlex's Change-O-Matic



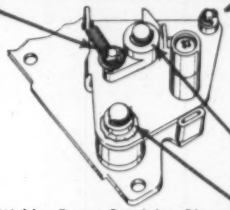
Viewlex, Inc., L.I.C., N.Y. solves a variety of fastening problems in their new model Change-O-Matic automatic slide changer. Assembly time is speeded, parts eliminated, rejects lowered, and compact, economical product design achieved.

### Connecting Arm Assembly



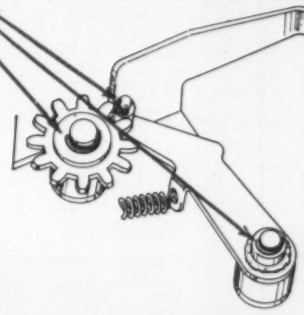
Use of one Waldes Truarc Ring (Series 5100) eliminates time-consuming riveting over the flange, retains and holds the connecting knob captive. A compact, neat design is made possible, rejects caused by poor riveting eliminated.

### Actuating Plate and Pawl Assembly



Three types of Waldes Truarc Retaining Rings are used in this assembly. One circular self-locking ring (Series 5103) retains pawl return spring. One external E-ring (Series 5133) retains roller used to prevent gear motion during transport cycle. One crescent ring (Series 5103) retains pawl which indexes gear. Second crescent ring retains sub-assembly. Truarc Rings speed assembly, cut rejects, eliminate parts.

### Detent Lever Assembly



Truarc E-ring (Series 5133) eliminates use of tapped hole and shoulder screw, retains roller which prevents over-travel of gear. Assembly is rapid.

**Whatever you make,** there's a Waldes Truarc Retaining Ring designed to improve your product... to save you material, machining and labor costs. They're quick and easy to assemble and disassemble, and they do a better job of holding parts together. Truarc rings are precision engineered and precision made, quality controlled from raw material to finished ring.

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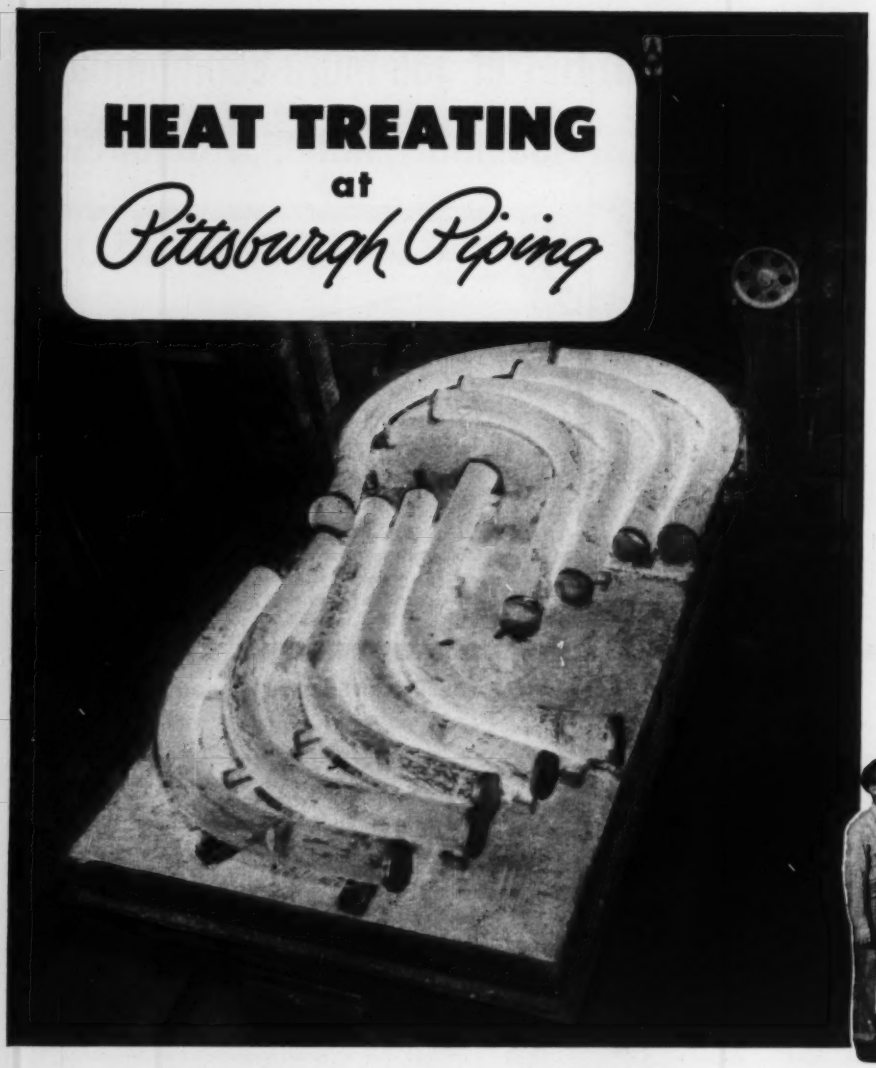
ME028

WALDES TRUARC Retaining Rings, Grooving Tools, Pliers, Applicators and Dispensers are protected by one or more of the following U. S. Patents: 2,382,948; 2,411,426; 2,411,761; 2,416,852; 2,420,921; 2,428,341; 2,439,785; 2,441,846; 2,455,165; 2,483,379; 2,483,380; 2,483,383; 2,487,802; 2,487,803; 2,491,306; 2,491,310; 2,509,081; 2,544,631; 2,546,616; 2,547,263; 2,558,704; 2,574,034; 2,577,319; 2,595,787, and other U. S. Patents pending. Equal patent protection established in foreign countries.

# HEAT TREATING at Pittsburgh Piping



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This heat treating procedure is assurance that piping fabricated by P.P.&E. will have the most desirable combination of ductility, toughness, impact resistance, and strength.

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PP-13

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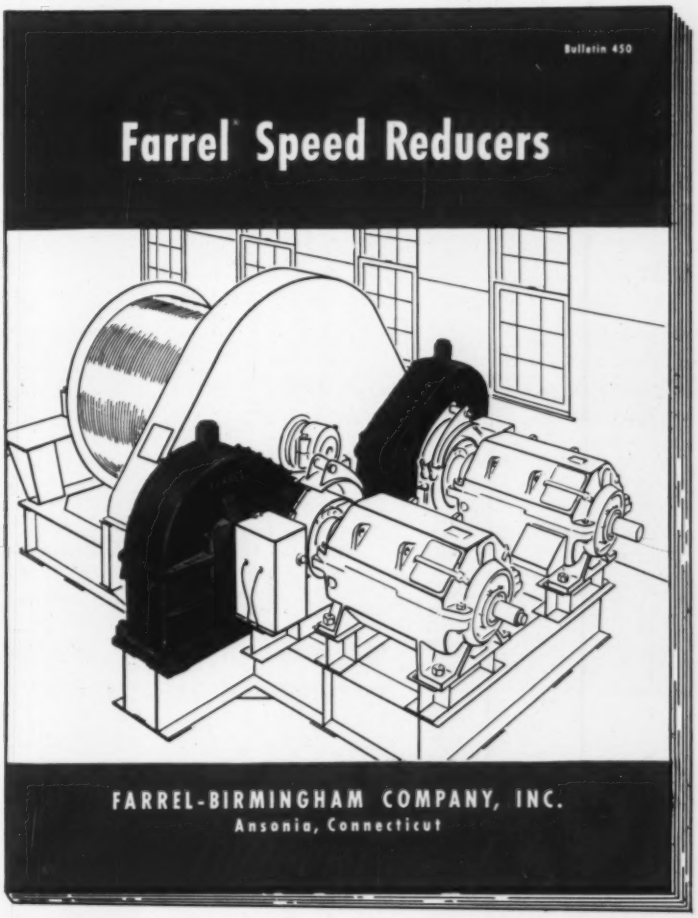


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All the information you need for quick selection of speed reducers for any application is in this comprehensive new book. Included are specifications, horsepower rating tables, overhung load capacities, dimensions and weights of the large variety of units comprising the Farrel line. This line has been recently re-engineered, rerated and expanded.

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## COMPARATIVE H T PROPERTIES OF BRITISH AND AMERICAN STEELS and an examination of British and U.S. procedures used to determine creep stresses

The first of the two papers in this booklet is a report on tests made by two laboratories, one in the United States, and the other in Great Britain on the same steel for the purpose of determining whether test techniques employed were liable to give different creep results and to compare the creep resistance of the selected steel. The second examines the more commonly used procedures practiced in both countries to determine creep stresses for the design of power plant for long life at high temperatures.

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This Glossary was compiled to clarify today's nuclear language, to contribute to the standardization of usage, and to provide scientists and engineers with a minor compendium of nuclear knowledge. Terms and definitions are alphabetically arranged and include those used in physics, reactor theory, reactor engineering, chemistry, chemical engineering, biophysics, radiobiology, instrumentation, isotopes separation, and metallurgy.

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*in larger sizes*

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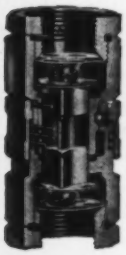
Snap-Tite's "H" Couplings are now factory-stocked for quick shipment to you, not only in the smaller sizes (below 1" ID) but in all sizes up to and including 3"—in steel, brass, aluminum, and 303 and 316 **Stainless Steel.** And "H" Couplings can be made to your order, up to 10" ID.



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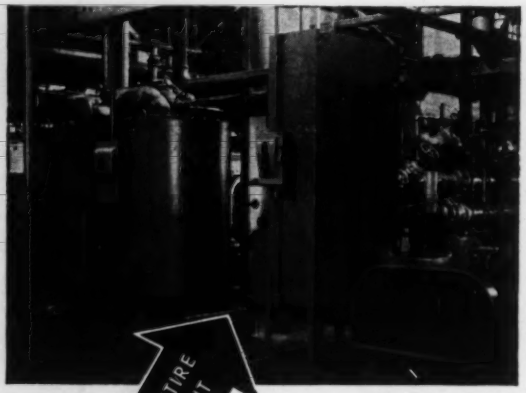

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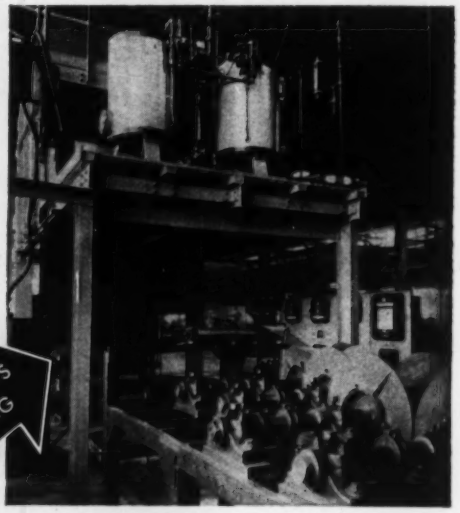

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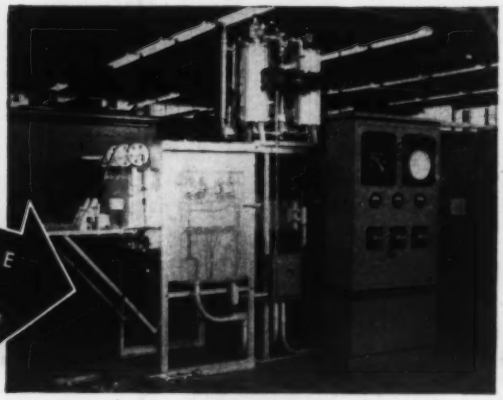

FOR A SINGLE FURNACE

YOUR CONTROLLED atmosphere generator builder can advise you on methods and equipment for all types of work—annealing, hardening, brazing, gas carburizing, tempering, sintering, normalizing. When a DRY gas is required, he'll quite likely include a Lectrodryer* in his recommendations.

Lectrodryers are handling hundreds of controlled atmosphere DRYing jobs throughout industry. Installations range from tiny laboratory operations to giant steel plant jobs. For DRYing help, consult your gas generator manufacturer. Pittsburgh Lectrodryer Corporation, 335 32nd Street, Pittsburgh 30, Pennsylvania.

In England: Birlec, Limited, Tyburn Road, Erdington, Birmingham.
In France: Stein et Roubaix, 24 Rue Erlanger, Paris XVI.
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## 416 Stainless throughout...

In the Marsh Needle Valve, operating men found a valve that was better all the way through. Then came the call for a valve of like quality and precision for corrosion service . . . to be 416 stainless steel throughout.

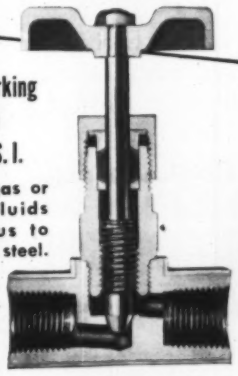
The valve illustrated here is the answer. Like the parent valve, this new valve has safety and strength to spare . . . guaranteed for working pressures up to 10,000 psi . . . equally efficient and effective in any lower pressure range.

It too is machined from solid bar stock—in this case, 416 stainless steel. Its precision-ground and-machined stem is hardened 416 stainless. Packing is the special "Marpak" ring . . . one-piece, non-binding, long-lasting. So finely built is this needle throttling and cut-off valve that it can be easily throttled down to exceptionally fine regulation even on extreme pressure.

Read the list of features opposite. Then write for new bulletin No. NV-2 containing complete details.

### 416 Stainless Steel ...all the way through!

- Body and stem guide machined from bar stock.
- Valve stem, hardened stainless.
- Packing, special Marsh "Marpak" moulded ring.
- Fine stem threads for strength and precision throttling.
- Deep inlet and outlet thread chambers.
- Bodies marked in accordance with MSS regulations.



**Maximum Working Pressure 10,000 P.S.I.**

**Water, oil, gas or corrosive fluids not injurious to 416 stainless steel.**

The new all stainless valves (Series 1924) includes globe and angle patterns with double female connections in sizes ⅛", ¼", ⅜", ½", ¾", 1"; also globe and angle valves with male inlet and female outlet in sizes ¼" and ½".

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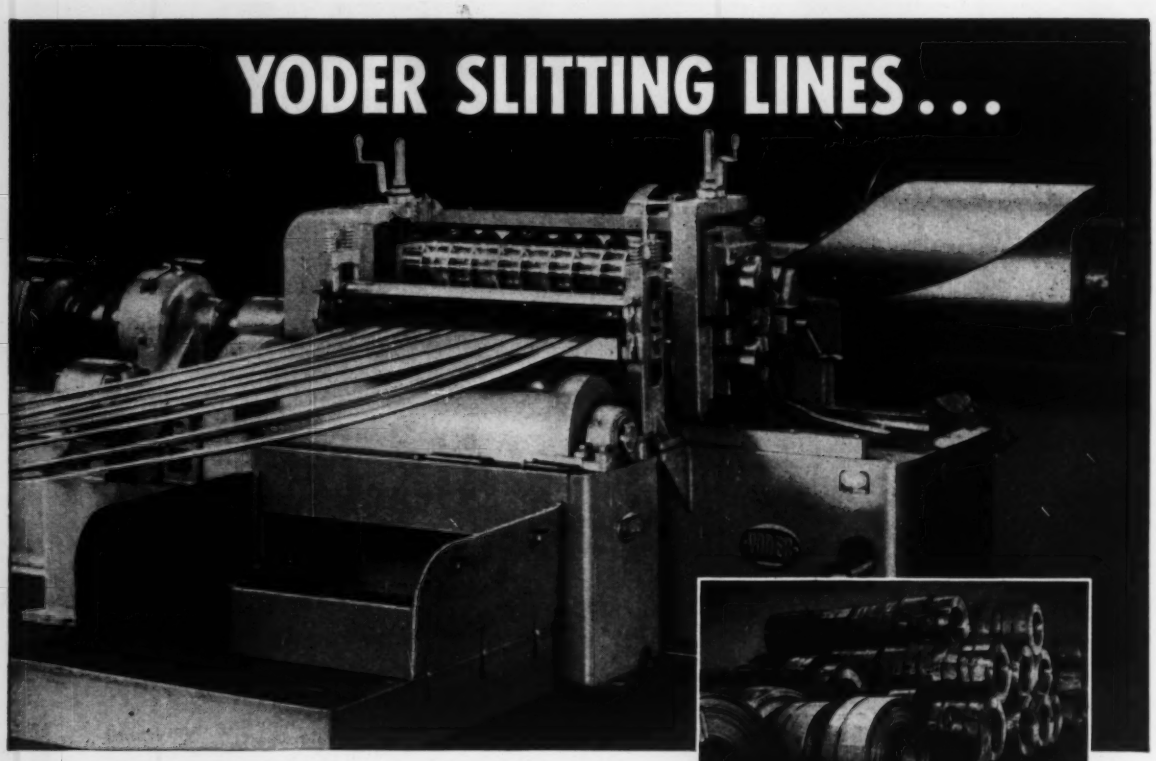
# MARSH

"THE STANDARD OF ACCURACY"

# YODER SLITTING LINES...



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## LOW FIRST COST AND OPERATING COST!

A relatively small, low-cost Yoder slitting line offers attractive savings possibilities and high production in slitting small and medium coil sizes and strip gauges. Yoder has standardized a series of such machines, affording a rare combination of low cost and productive capacity amply sufficient for the needs of the great majority of sheet metal fabricators and custom slitting shops. Supplementing the standardized series are *special models for slitting big coils and heavy gauges at high speeds.*

For requirements as low as 100 tons per month, one of the standardized Yoder slitting lines will pay for itself in short order. The savings PER TON increase rapidly with decrease in coil size and width of strands to be slit.

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*Yoder Slitter Book* contains basic information on the economics and mechanics of slitter operation, with time and cost studies, production records and other valuable data. Send for it.

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**COLD ROLL FORMING MACHINES**

**ELECTRIC-WELD PIPE AND TUBE MILLS**

How
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Nordstrom
**VALVES**

# Cut Your Processing Costs

For more than forty years, Rockwell-Nordstrom *lubricated* plug valves have been proving that they cut costs by doing their job better, longer, with less maintenance. Here's why:

1. Pressurized lubricant forms a positive, leakproof seal, preventing dangerous or costly leakage.
2. Metal-to-metal friction is eliminated by lubricant. Maintenance, repair and down time costs are slashed on even the toughest service.
3. Costly production loss by stuck valves is prevented. The tapered plug is hydraulically seated for *instant, quarter-turn* operation.

Rockwell-Nordstrom valves cost about the same, often less, than ordinary valves. Their cost to use and trouble-free dependability cannot be matched by any other valve. Available in semi-steel, steel, stainless and corrosion resisting metals, in a full range of sizes to 30″. Send the coupon today for complete details.

*Canadian Valve Licensee:* Peacock Brothers Ltd.

40th YEAR

*of lubricated plug valve leadership*

**ROCKWELL-**
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**VALVES**

**Lubricant Sealed for Positive Shut-off**

ROCKWELL MANUFACTURING COMPANY, Pittsburgh 8, Pennsylvania

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● A new dual-beam cathode-ray oscillograph with facilities for precise observation, comparison and measurement of two related a-c or d-c signals.

Has two complete vertical amplifiers with response flat to d-c and uniform within 30% to 300 kc. Amplitude measuring on both channels includes 16 ranges from 400 volts full scale to only 4 millivolts for full deflection to scale limits. The most sensitive range permits a-c or d-c measurements in the microvolt region. Balanced input is available on the seven most sensitive ranges.

High-level, accurate, calibrated, linear sweeps; automatic beam gate; sweeps range from 1 sec./inch to 2 usec./inch in 19 steps common to both channels.

X-amplifier provides up to 20 inches of undistorted sweep expansion; external horizontal input to either or both channels.

*Observe, compare and measure two related AC or DC signals with the new, high precision*

PRICE
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# DU MONT TYPE 333
## CATHODE-RAY OSCILLOGRAPH

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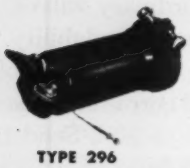

**TYPE 296**

Versatile, economical 35 mm general-purpose oscillograph record camera with f/2.8 lens. Price $149.50

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DU MONT TECHNICAL PRODUCTS DIVISION
Allen B. Du Mont Laboratories, Inc., 760 Bloomfield Ave., Clifton, N. J.

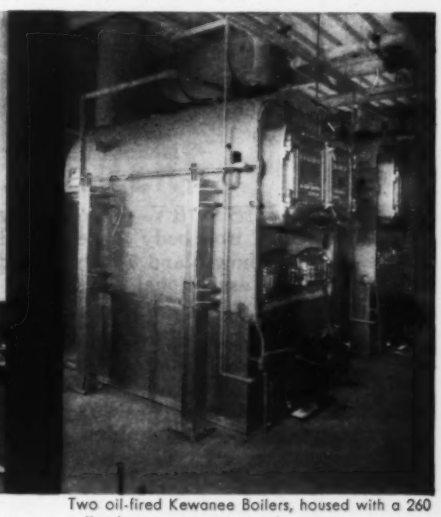
# How Kewanee creates "safe weather" for fish...

KEWANEE reserve plus rated boilers

*maintain constant temperature*

Water temperature is like weather to fish and sudden variations of only a few degrees can be fatal. The problem at Marineland, world's largest oceanarium, Los Angeles County, California, is to meticulously maintain temperatures so its priceless deep sea specimens are not endangered. That's where Kewanee Boilers came in. Cold water from the sea is brought in at the rate of 2,000 gallons per minute. It is vital that boilers offer unfailing service so the inside water temperatures remain constant despite the ceaseless flow of water from the outside. Architects Pereira & Luckman specified Kewanee Reserve Plus Rated Boilers with 50% extra power built-in to take care of fluctuating demands. Only with reserve power could Marineland be sure its rare collection would be protected. And only boilers rated on nominal capacity with built-in reserve could meet the changing demands. So, if your problem is one of maintaining heat against as sharply a defined need as a few degrees change in temperature, or the broad problem of assuring sufficient power when expansion comes, choose Kewanee. You can be sure of unfaltering service.

Marineland Oceanarium, Los Angeles County, California, where rare fish are protected by Kewanee Boilers which assure uniform water temperature. Architects & Engineers: Pereira & Luckman/ Heating Contractor: Mehring & Hanson Company



Two oil-fired Kewanee Boilers, housed with a 260 gallon hot water storage tank.

KEWANEE BOILER DIVISION
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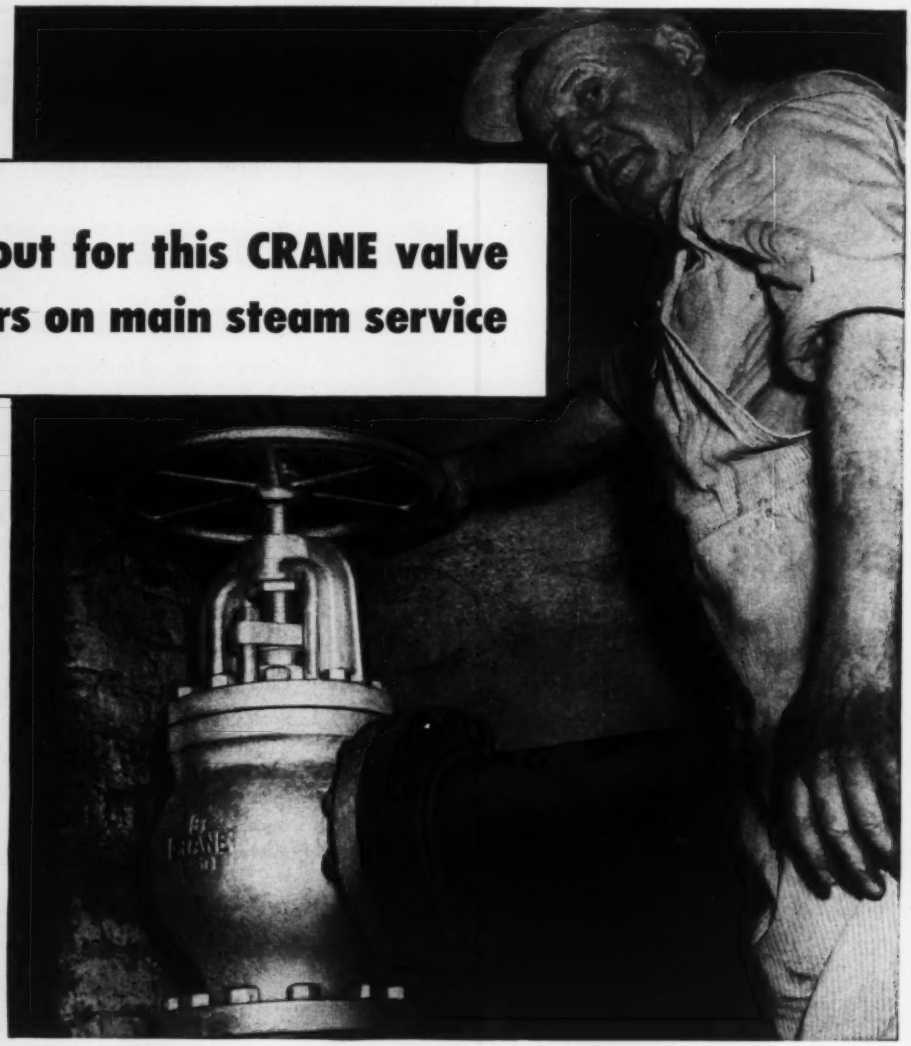
KEWANEE BOILERS

*You can depend on Kewanee Engineering*

# No time out for this CRANE valve in 40 years on main steam service



THE CASE HISTORY—Two Crane 250-pound iron body angle valves—6-inch (shown) and 5-inch size—scored this exceptional service record.

They were installed in 1915 on the main steam leads from boilers in the plant at Delavan, Wis., now occupied by The George W. Borg Corporation. In 40 years' uninterrupted service these Crane valves never failed to operate properly nor caused a shutdown. With but routine maintenance, they opened fully and were seated tight with ease under infrequent operation. Working pressure of boilers was originally 150 psi.—later reduced to 75 psi. This year, both valves were retired. The new replacements are Crane quality valves, of course.

Crane iron valves in particular need no introduction to thrifty buyers. In all grades, Crane iron castings generously exceed the requirements of equivalent A.S.T.M. specifications. Crane Ferrosteel, for instance, used in 250-pound valves is 35% stronger than ordinary cast iron.

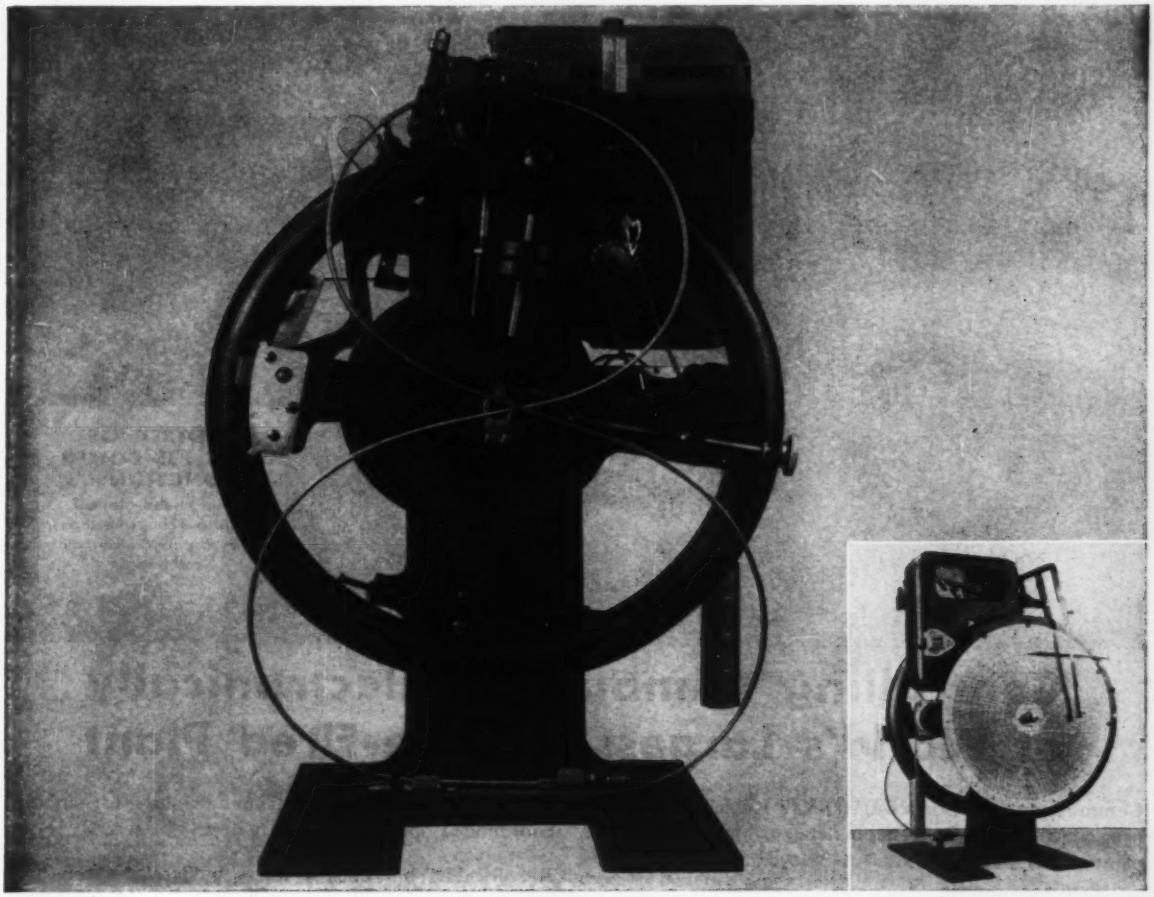
In any pressure class, you'll find Crane quality outstanding. Choose from complete lines of gates, globes, angles and checks.

Your Crane Representative can give valuable help in specifying and ordering.

**CRANE VALVES & FITTINGS**

**PIPE • KITCHENS • PLUMBING • HEATING**

*Since 1855—Crane Co., General Offices: Chicago 5, Ill. Branches and Wholesalers Serving All Areas*



Recording and integrating Model 2656
(case removed)

*Simple, direct action makes*

# HAGAN RING BALANCE METERS

***tops in Accuracy and Dependability***

Simple, direct action and sturdy construction assure dependable, trouble-free service in Hagan Ring Balance Meters. The famous Ring Balance principle produces high accuracy, even at low differentials and at low rates of flow.

Hagan Ring Balance Meters are available for any gas or liquid flow measurement. Check these many outstanding features and see how they can help you get accurate and dependable metering with really low maintenance.

- **Calibration of meter may be checked with dead weights in a few minutes, without disconnecting the meter from the line.**
- **No stuffing boxes are used in Ring Balance Meters.**
- **No mechanism in contact with fluid being measured.**
- **The differential measuring range of any ring is readily adjustable over a 7 to 1 ratio.**
- **Calibration is independent of the amount of sealing liquid.**
- **A complete series of interchangeable sensing elements is available for measuring full scale differentials from 1" to 420" WC, at static pressures up to 3000 psig.**

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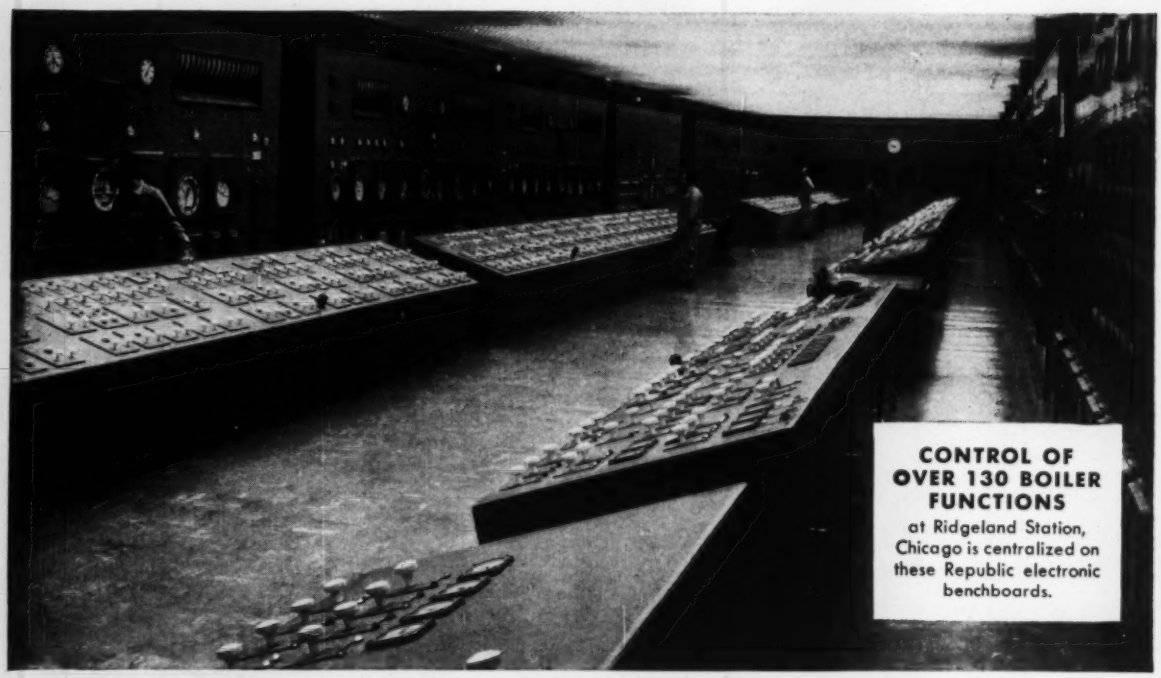


**CONTROL OF OVER 130 BOILER FUNCTIONS** at Ridgeland Station, Chicago is centralized on these Republic electronic benchboards.

# Controlling Combustion Electronically at World's Largest Cyclone-Fired Plant

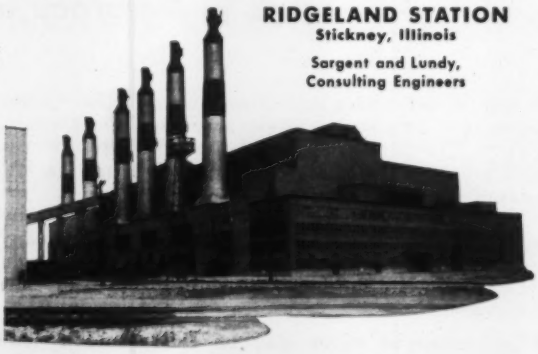
Commonwealth Edison's 640,000 KW Ridgeland Station near Chicago is the largest completely cylone-fired power plant in the world. A total of 28 cyclone furnaces fire the plant's six boilers.

To maintain maximum firing efficiency, combustion conditions at each cyclone are individually controlled and integrated with over-all plant operation by a Republic Electronic Combustion Control System. The system provides separate controls for primary air, secondary air, fuel feed and fuel-air ratio at each of the 28 cyclone furnaces in addition to controlling forced and induced draft fans and feedwater pumps on each boiler. All told, there are more than 130 individual controls which are automatically coordinated for continuous proper combustion.

Republic Electronic Controls handle all of these functions without introducing transmission lags, complicated pneumatic-mechanical linkages and inaccuracies due to mechanical inertia into the control system. Integration of control information is greatly simplified by use of electronic circuits. Expensive panel piping is eliminated and control panels are easier to operate. Because transmission of control impulses is electrical, all parts of the control system can respond simultaneously for smooth, coordinated operation of the boilers.

Ridgeland is but one of many modern cyclone-fired power plants that are equipped with Republic Combustion Controls. In fact, more cyclones are controlled by Republic than by any other make of controls.

Republic makes a complete line of combustion controls for all types and sizes of boilers, all methods of fuel firing, all load conditions and all arrangements of draft. Write us when your problem is combustion controls.



**RIDGELAND STATION**
**Stickney, Illinois**
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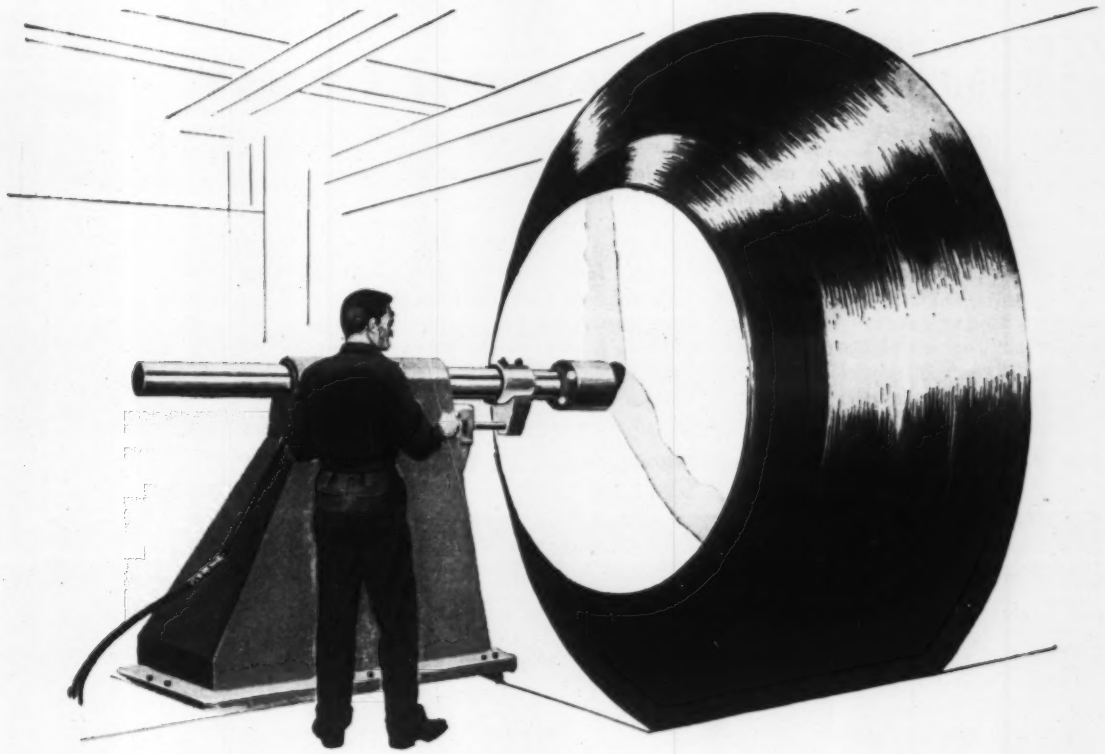
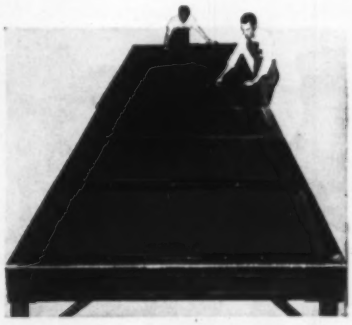
**REPUBLIC FLOW METERS CO.**
**2240 Diversey Parkway, Chicago 47, Illinois**



# FORMICA S-52 *for better and more economical metal forming*

| FORMICA S-52 IS: | which means: |
|---|---|
| smooth, scratch resistant | It will not transfer any surface irregularities |
| flat | It's free from peaks and valleys |
| light weight | One man can lift and handle larger pieces |
| dent resistant | It's 8 times stronger than hard maple |
| economical | It's much cheaper than metal tooling plate |
| easy to machine | It's easier and cheaper to machine than any metal |
| corrosion resistant | It will not rust |
| friction resistant | Thin metal sheets can be formed and removed from S-52 dies without sticking, splitting or tearing |



*Light weight* of S-52 makes handling easy. One man can now lift and carry a plate that formerly required 3 or 4 men.

**Formica S-52 laminated plastic is a much more economical forming material than metal tooling plate, easier and cheaper to machine. It's ideal for aviation and automotive tooling, gauging, templates, stretch forming, forming dies, hydro-press forms; metal spinning chucks, pattern boards, drill jigs, gluing jigs and many other applications.**

The new S-52 is smooth, slick as glass. Forms metal without transferring surface irregularities. It's 8 times stronger than hard maple in dent resistance. And yet it's easy to machine with conventional metalworking tools.

Now available in sheet thicknesses up to 3″; widths 24″, 30″, 36″; lengths 42″, 60″, 72″, 84″, 96″. Sheets 36″ x 96″ in stock for prompt delivery. For further information on how you can use S-52 for better, more economical metal forming, write today for free bulletin 604 and data sheet. The Formica Co., 4611 Spring Grove Ave., Cincinnati 32, Ohio.

★ *Application engineering*

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★ *Research*

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*Formica-4 makes Formica 1st choice in laminated plastics*

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FIG. 3003 WE—Steel Gate Valve For 300 Pounds W.S.P.

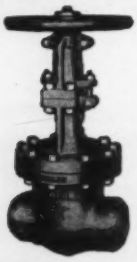

FIG. 11365—Steel Pressure Seal Horizontal Lift Check Valve For 1500 Pounds W.S.P.

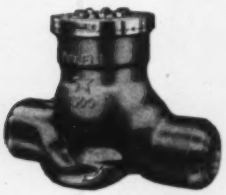

FIG. 11323—1500-Pound Motor Operated Steel Pressure Seal Gate Valve.

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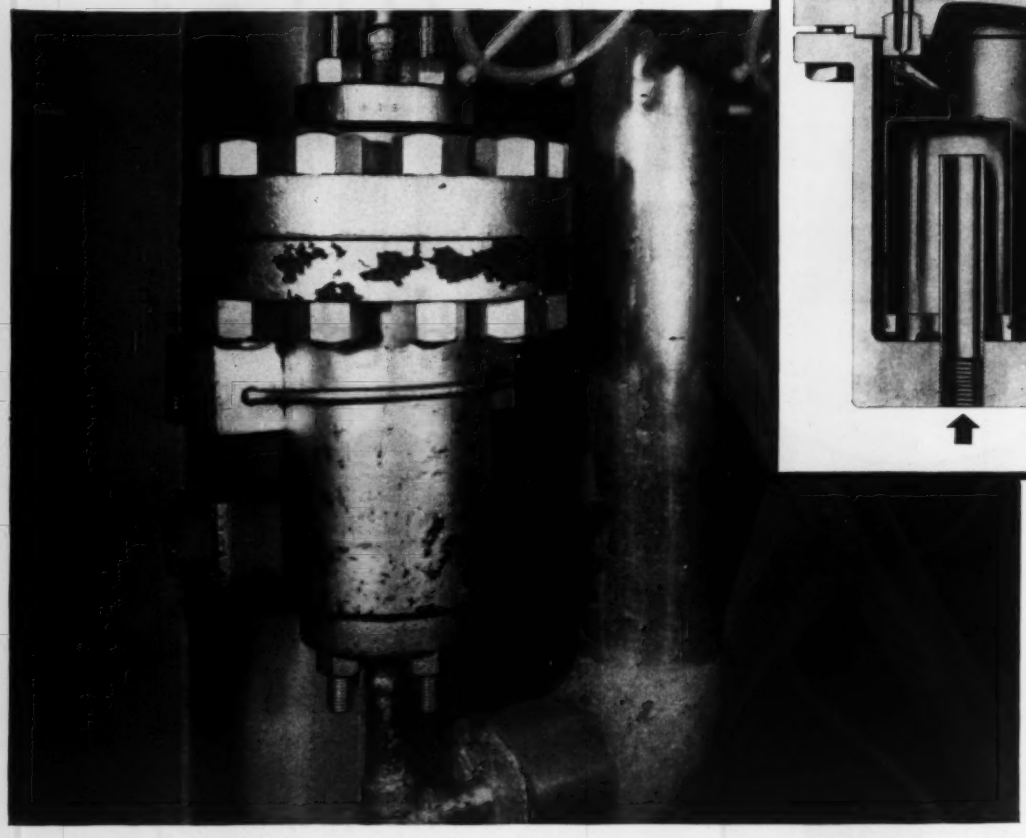

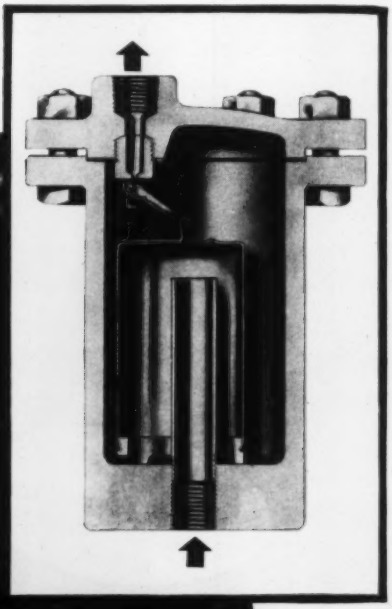

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| VALVE AND SEAT | Type 440 chrome steel, heat treated, standard. Stellite available. |
| LEVER MECHANISM | Stainless steel |
| BUCKET | Stainless steel |
| BOLTS | Class C high tensile, high temperature bolting material—125,000 min. tensile. |
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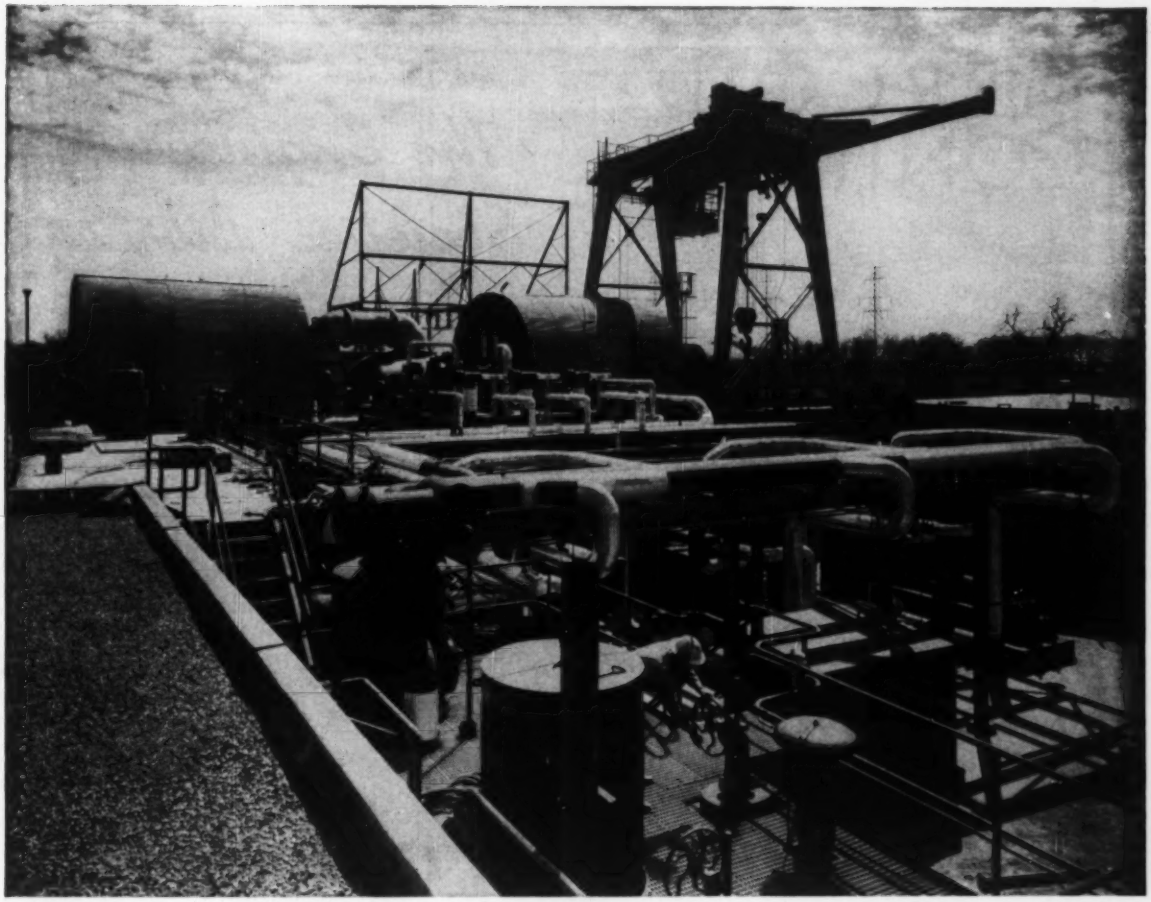

Note boiler feed piping, some covered with aluminum—turbine on left, generator on right enclosed in temporary sheds

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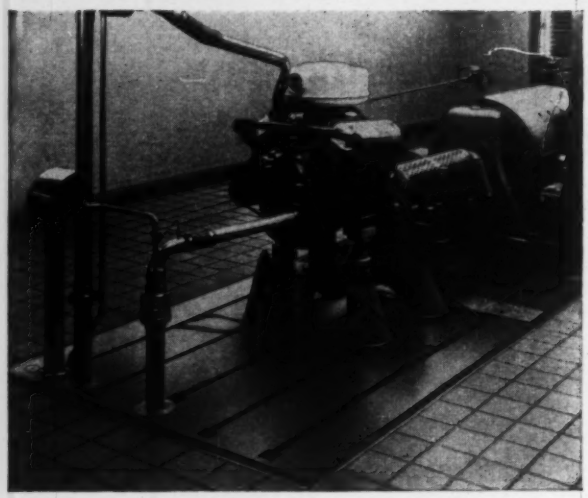

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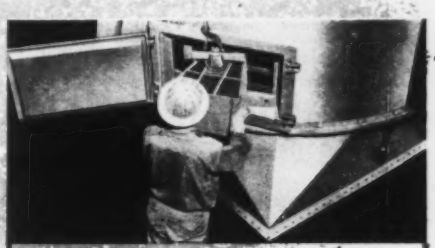

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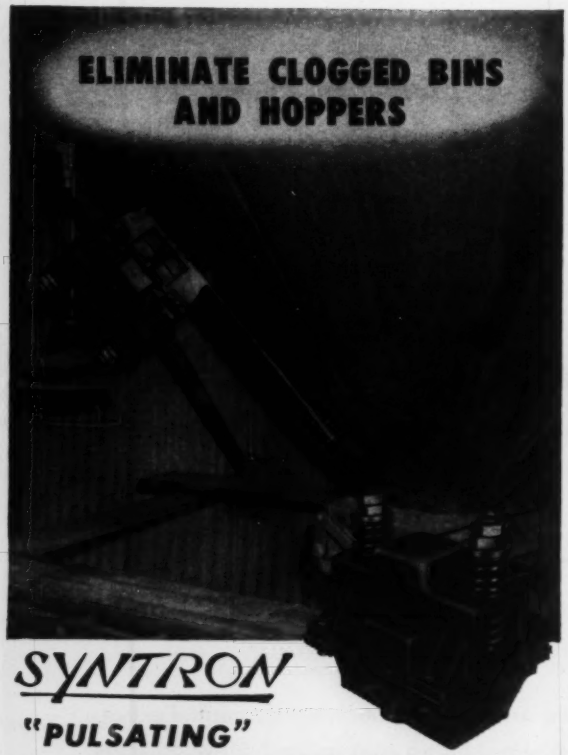

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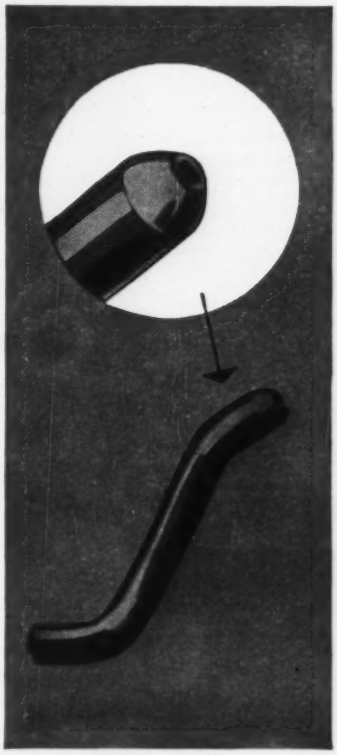
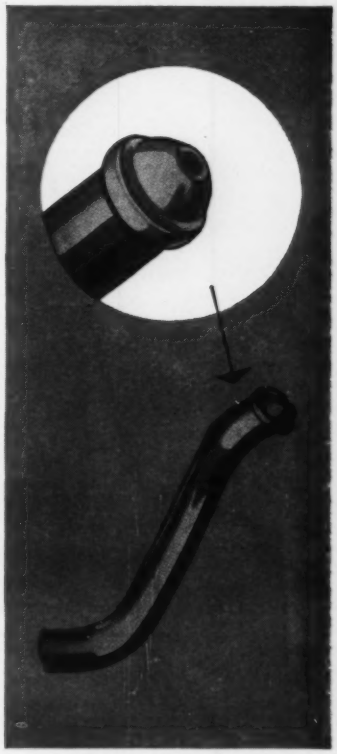


**Problem:** This 3/16" O.D. timing-gear oiler tube, shown above, required a tapered end for a nozzle effect. As specified by the customer, it required numerous swaging operations. Bundy engineers, always on the lookout for new ways to shave costs, hit upon the ingenious solution shown at right. With the customer's consent, original specifications were changed.



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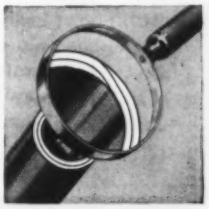

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Introduction, J. W. Daily ..... 1056
The Turbomachinery Compressor, H. W. Emmons ..... 1056
Hydraulic Prime Movers, A. T. Larned ..... 1058
Water Hammer, S. L. Kerr ..... 1059
Centrifugal Pumps, Ralph Watson ..... 1060
Cavitation, R. T. Knapp ..... 1063
Analysis of Development Trends in Industrial Diesel-Power Units, C. G. A. Rosen ..... 1065
The Economics of Combustion, E. G. Bailey ..... 1071
How ASME Celebrated Its 75th Anniversary, J. H. Davis ..... 1103
"To Enrich Mankind"—First ASME Motion Picture ..... 1108
The Nuclear Engineering Division, A. C. Pasini ..... 1111
ASME Honors Outstanding Engineers ..... 1113
Editorial ..... 1041
Briefing the Record ..... 1078
European Survey ..... 1092
ASME Technical Digest ..... 1094
ASME News ..... 1144



**MECHANICAL ENGINEERING**
**January, 1956 CARD INDEX Vol. 78, No. 1**

The Future of ASME, D. W. R. Morgan ..... 4
"Taslan"—Textured Yarn, J. T. Rivers, Jr. ..... 7
Future of Synthetic Liquid and Gaseous Fuels, H. R. Batchelder and H. W. Nelson ..... 11
Unit Loads for Bulk Materials, E. O. Dean and J. H. Norton ..... 15
Adhesive Bonding of Metals, S. N. Muchnick ..... 19
Bending and Impact Tests of Cast-Iron, Cast-Steel, and Nodular-Iron Valve Bodies, J. O. Jeffrey and R. H. Hanlon ..... 23
Professional Aspects of the Practice of Engineering, R. G. Warner ..... 28
The ASME Council Reports Activities in 1954–1955 ..... 53
1955 75th Anniversary ASME Annual Meeting ..... 66
Availability List for 1955 ASME Annual Meeting Papers ..... 91
Editorial ..... 3
Briefing the Record ..... 31
European Survey ..... 44
ASME Technical Digests ..... 46
Comments on Papers ..... 95
Reviews of Books ..... 97
ASME Boiler and Pressure Vessel Code ..... 101
ASME News ..... 104



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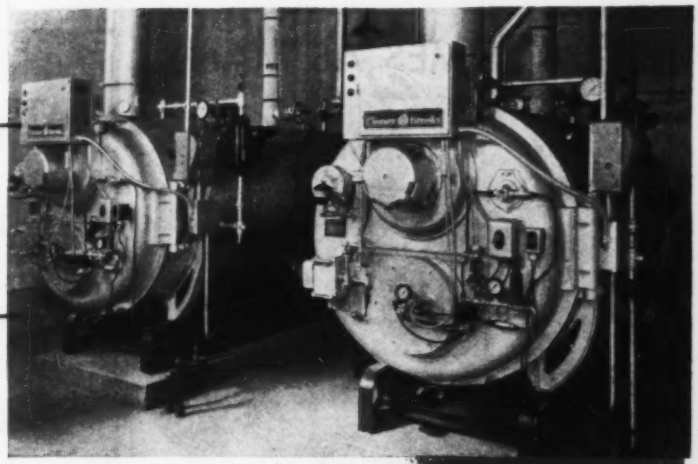

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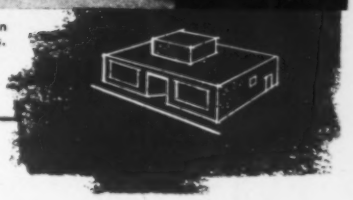

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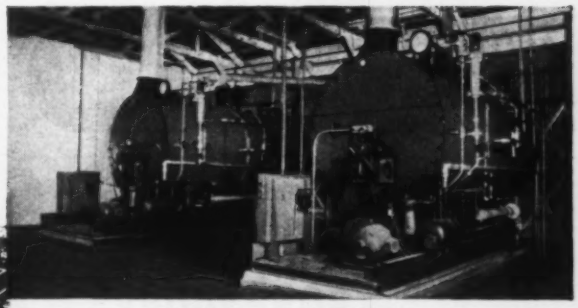

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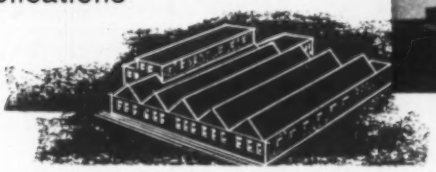

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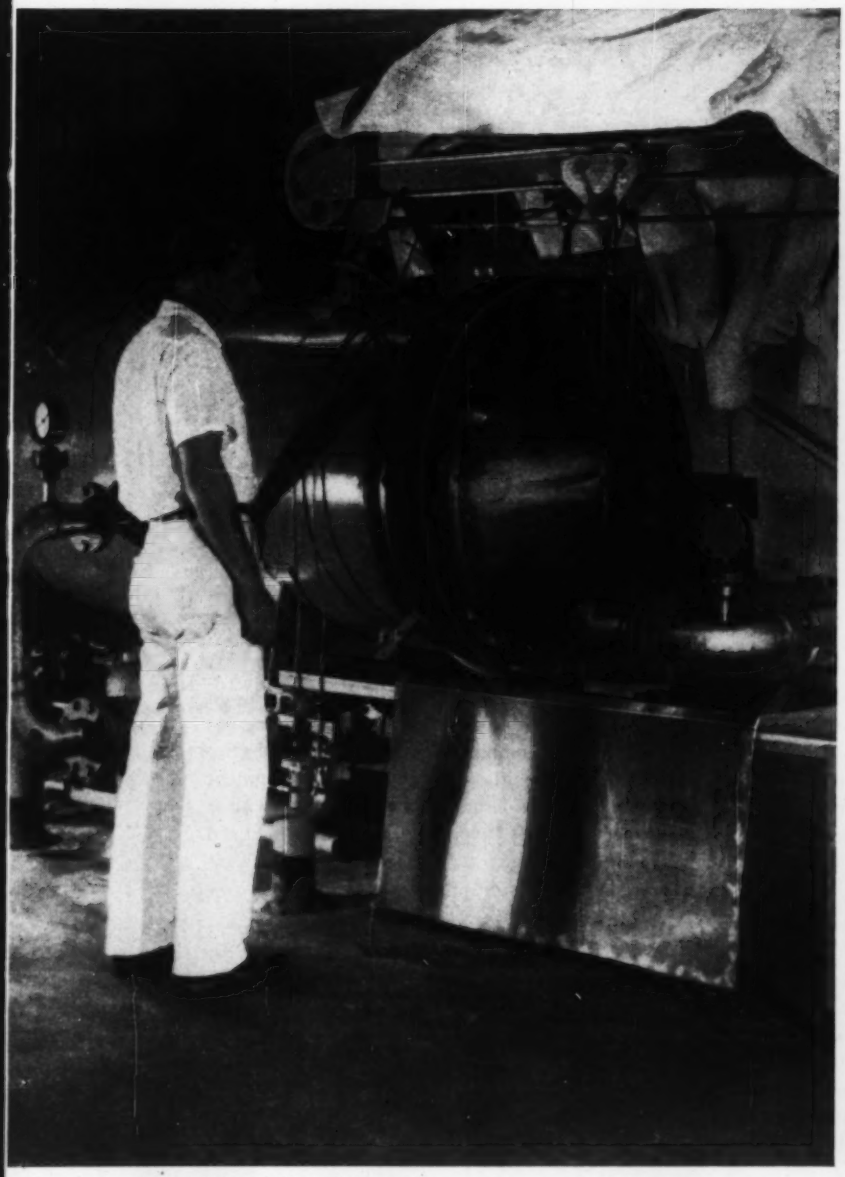

**FOR CORROSION RESISTANCE.** The Norwich, N. Y. plant of Norwich Pharmacal Company is a magnificent display of Stainless Steel. Shown here is a Stainless Steel filter, used to separate mother liquor from the solids of furoxone. Here, Stainless outlasts any other practical metal by two to one.

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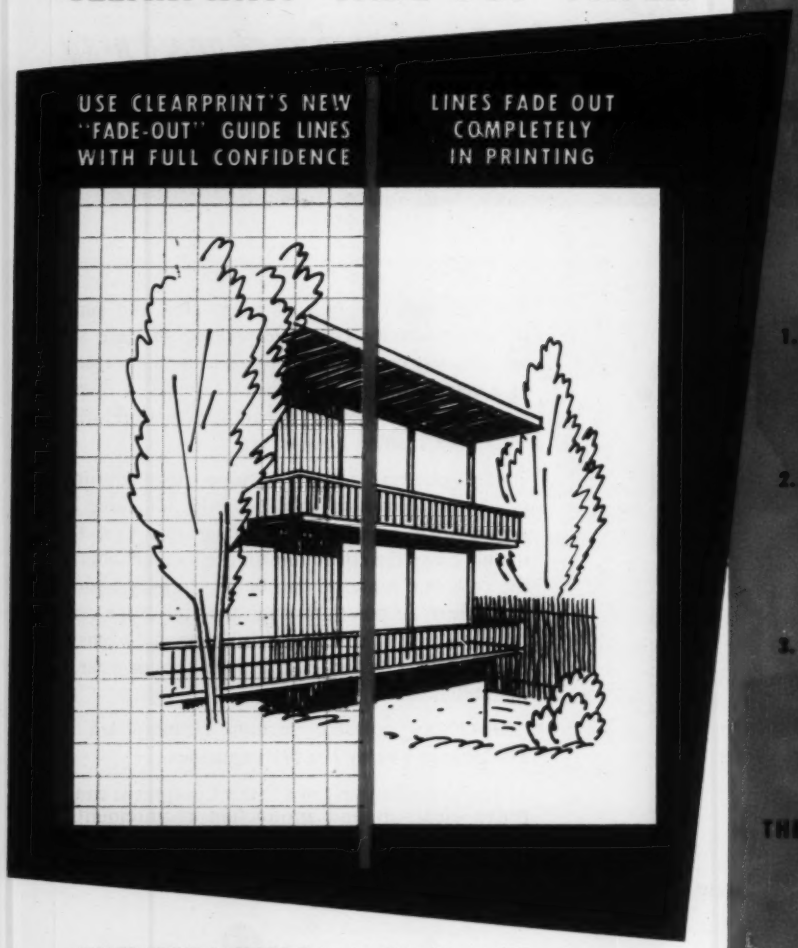


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*Answers to box number advertisements should be addressed to given box number, care of "Mechanical Engineering," 29 West 39th St., New York 18, N. Y.*

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**MECHANICAL DESIGN ENGINEER**

Qualifications will include 4 years' or more experience in mechanical design of pressure vessels and heat exchangers. Applicant should have a thorough knowledge of the ASME Code for Unfired Pressure Vessels and be familiar with fabrication and shop practices. Salary commensurate with ability and experience. Send resume.

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Excellent opportunity with consulting engineering firm in Middle West. Liberal benefit plans and good working conditions.

Send resume of education and experience with statement of salary requirements.

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Power Plants
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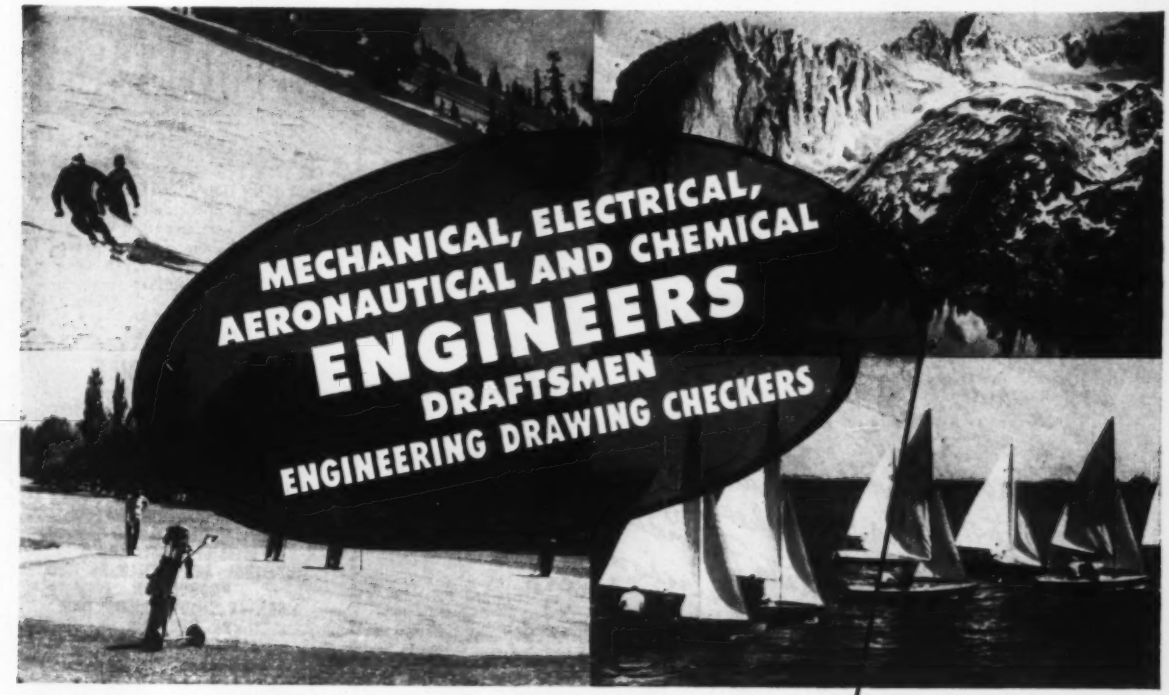


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**A** *ttractive living*

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Tell them to write to:

Don Dionne
Farnsworth Electronics Co. Fort Wayne, Ind.
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Sincerely
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*Please send your resume to:*
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**EXPERIENCED**
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**For Experimental Automotive Work in Transmissions, Engines & Chassis.**

The Engineering Staff is located in the Suburbs of Detroit on an 820 acre site devoted to research and development work. Splendid opportunity for men looking toward the future. Ideal working conditions in well lighted, air conditioned office building. Fine recreational program with golf course adjacent to site. Opportunity to become a share holder in GM through a generous Stock Purchase Program. Also excellent health insurance, life insurance, and retirement plans.

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Position requires experience in process and power piping arrangements, layouts and diagrams as related to chemical and petroleum industries. Experience should include basic piping fundamentals along with economical design layouts.

Principal duties will be to transform research and operating data into the design of new plants. Applicant will be expected to make independent analysis, exercise individual judgment, coordinate the work of others and make periodic trips to construction sites to assist in installation problems and start-ups.

## EQUIPMENT DESIGNER-ENGINEER

Qualifications will include experience in the design of equipment for either chemical or petroleum industries. Applicant should have a thorough knowledge of the ASME Code for Unfired Pressure Vessels and be familiar with fabrication and shop practices as they affect economical design.

Successful applicant will develop and analyze unique equipment designs for use in complex chemical processes that have heretofore been untried. Periodic trips to field installations and vendor shops will be required in order to view fabrication and installation of equipment and assist in start-ups.

## INSTRUMENT DESIGNER-ENGINEER

Desirable background will include experience in the application and installation of instruments for the control of chemical processes. Applicable design experience should be in pneumatic and electronic instrumentation for the measurement and control of process variables, including layout of complex graphic type panels.

Successful applicant will design and engineer systems as outlined above, giving consideration to economic installation and maintenance features. He will also assist in the development of control diagrams, prepare installation layouts and detailed hook-ups for unique application, write specifications and assist construction personnel in installation problems.

## POWER DESIGNER-ENGINEER

Qualifications will include background in the design of industrial plant facilities required to supply utility services to chemical processes. Applicable design experience should be in steam generation and distribution, water supply and treatment, refrigeration, fire protection, outside pipe lines, process waste disposal and industrial furnaces.

Designers selected will design and engineer a variety of the above mentioned facilities as are required by new or existing chemical processes. Work can involve not only economic installations, but also the challenge of meeting special requirements in connection with process problems.

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**Feb. 26-27-28-29 (Sun.-Mon.-Tues.-Wed.)**
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Theoretical analysis of heat transfer-fluid flow problems applied to the design and operation of nuclear reactors leading to fundamental relationships and engineering design methods. Experience (including academic background) desirable but not essential. Long range program. U. S. citizen. Starting salary ranges: B.S. $5,000–8,000; M.S. $5,500–8,500; Ph.D. $7,500–10,000. Opportunities for advanced study or academic appointment. Send details of education and experience to:

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Positions available for

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## CHEMISTS

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Unique reactor power plant components—heat exchangers, pumps, valves, etc.

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Areas of applied mechanics and stress analysis.

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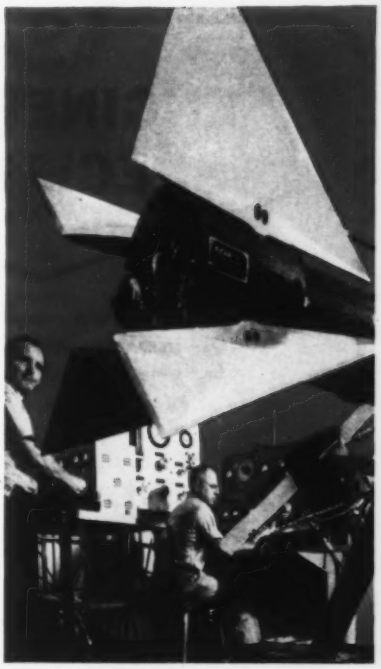

# MISSILE GUIDANCE AT Bendix IN SOUTHERN CALIFORNIA

In connection with its long range Missile Guidance programs Bendix-Pacific has excellent positions for Electronic Test Equipment Designers, Circuit Designers and Microwave Engineers.

Bendix also has unusual engineering positions in electrical and mechanical design of airborne radar and telemetering.

You are invited to consider becoming a member of this far sighted engineering organization in Southern California.

**Please fill in the coupon or write us for complete information.**

W. C. Walker, Engineering Employment Manager
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I am a graduate engineer with ____
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Name ____
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The Accessories Division of Thompson Products, Inc., offers you the opportunity to strengthen your technical foundation as you contribute to the progress of the Division.

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The Accessories Division is a leading manufacturer of aircraft accessories and products. You will have the chance to advance your career as you assist the Division to pioneer in aircraft systems and accessories. Your work will consist of preliminary analysis, problem studies, consultations and experimental research.

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**ALSO OPENINGS FOR DEVELOPMENT ENGINEERS AND DESIGN ENGINEERS**

**For project work on engine controls, booster pumps, gear pumps and turbine power units.**

Plant located in suburban Cleveland near beautiful residential areas.

*Submit complete resume, including past earnings and availability for interviews in first letter to Vic Buescher (M.E.)*

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**Fire Control** — technically direct a major Radar Fire Control project.

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Join stimulating associates already in this highly-advanced field with an electronics pioneer.

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Attractive opening in Esso Engineering for a Standards Engineer. Will work with a group of engineers preparing engineering standards and standard purchase specifications for oil refinery equipment.

Candidates should be graduate engineers not over 35 years of age. Broad background of at least five years' experience with oil refinery equipment desired.

Give full and specific details of education, experience, desired salary, availability date and references.

All inquiries will be considered promptly and held confidential.

**Esso Research and Engineering Company**
**(Formerly Standard Oil Development Company)**
**Personnel Division**
**P. O. Box 51** **Linden, N. J.**

***Lockheed diversification in action...***

At right: engineers and scientists work on some of the 46 major projects in progress at Lockheed

*Operations Research discussion on continental defense*

**Operations Research openings**

Electronics Specialists
Fire Control and Guidance Specialists
Aerodynamics Engineers
Physicists

*Fatigue test on Super Constellation skin*

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Research Specialists
Structures Engineers
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Aircraft experience is not necessary to join Lockheed. It's your engineering training and experience that count. Lockheed trains you for aircraft engineering—at full pay.

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*Aerodynamic meeting on high-speed fighter*

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# 22 Pages of "OPPORTUNITIES"

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To initiate and direct the design, testing and customer liaison associated with valve and piping developments for atomic power and other nuclear activities. Advancement prospects excellent with company highly regarded for products and research work in power and process fields. Salary open, replies confidential. Write or contact Personnel Director.

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Interesting projects involving thermodynamics, heat transfer, fluid flow, distillation, vacuum technique, equipment design, instrumentation and controls, process engineering, pilot plant design and operation.

Research, as well as practical design and development engineering. Projects associated with production and distribution of oxygen, nitrogen and argon as low temperature liquids or as gases.

- Bachelors, Masters, or Ph.D. Degrees
- Send resume of educational background (please include approximate academic standing) and work experience to:

**LINDE AIR PRODUCTS COMPANY**
a division of
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**P. O. Box 44**
**Tonawanda, New York**
**Attention: Mr. Paul I. Emch**
**Refer to Ad: ME LTE**

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**Mechanical Engineers** required for process design, refinery planning and layout, cost estimation, mechanical design, materials and equipment development for complete refineries and refinery units. Positions available in manufacturing work for project engineering, field engineering and equipment maintenance.

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Give full and specific details of education, experience, desired salary, availability date, and references.

All inquiries will be considered promptly and held confidential.

**ESSO RESEARCH AND ENGINEERING COMPANY**
(Formerly Standard Oil Development Company)
**Personnel Division**
**P. O. Box 51** **Linden, New Jersey**

engineer, **ME or EE**

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Research facilities that enable you to test out your most revolutionary ideas and encouragement to publish original work are available to the engineer experienced in precision gyroscopic equipment.

Assignments in the field of missile guidance systems will include both mechanical and electrical problems involving lubrication, temperature control, bearings, vibration and shock mounts, development work in components such as pickups, accelerometers, amplifiers and computers, plus project work on complete gyroscopic systems.

**ME, EE** or equivalent experience required. Send resume in confidence to:

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Division American Bosch
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This integrated engineering and manufacturing firm has increased its annual sales volume 600 per cent in five years to eighteen million dollars. The chemical, petroleum and metallurgical industries now depend on low temperature processing as an integrated part of their expansion plans requiring oxygen, nitrogen, argon, hydrogen, carbon monoxide, methane, and other high purity low molecular weight cases and hydrocarbons.

The company is seeking an ambitious, self energizing, young chemical or mechanical engineer who is capable of participating in large scale contract negotiations with engineering and management personnel for the sale or lease of complete processing systems. This is an excellent opportunity to progress into management responsibility with the country's leading company in this new and rapidly growing field. Salary and profit sharing. Send application to B. H. Van Dyke.

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Dr. Lloyd H. Wilson, thermodynamics group head, Robert S. Swanson, manager of the aerodynamics department, and Howard Jackson, aeronautical engineer, determine heat transfer coefficients from high-speed missile flight records

MISSILE SYSTEMS

# THERMODYNAMICS ANALYSIS

The Aerodynamics Department of Lockheed Missile Systems Division is engaged in a comprehensive research and development program which combines experimental work and theoretical analysis in the field of aerothermodynamics. These investigations consider extreme environmental conditions for all types of missile systems and components.

A typical problem now under study is concerned with the evaluation and interpretation (including a careful "error" analysis) of thermal flight test data as it relates to the heat transfer from the high-speed boundary layer through the structure of an integral fuel tank to a cryogenic fluid. Other research studies relate to the analytic and experimental determination of the supersonic and hypersonic characteristics of bodies to provide basic understanding of the aerodynamic and thermodynamic flow and design information. Important work in the field of thermal stress is in progress.

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*Lockheed*

**MISSILE SYSTEMS DIVISION**

*research and engineering staff*

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MECHANICAL ENGINEER

or

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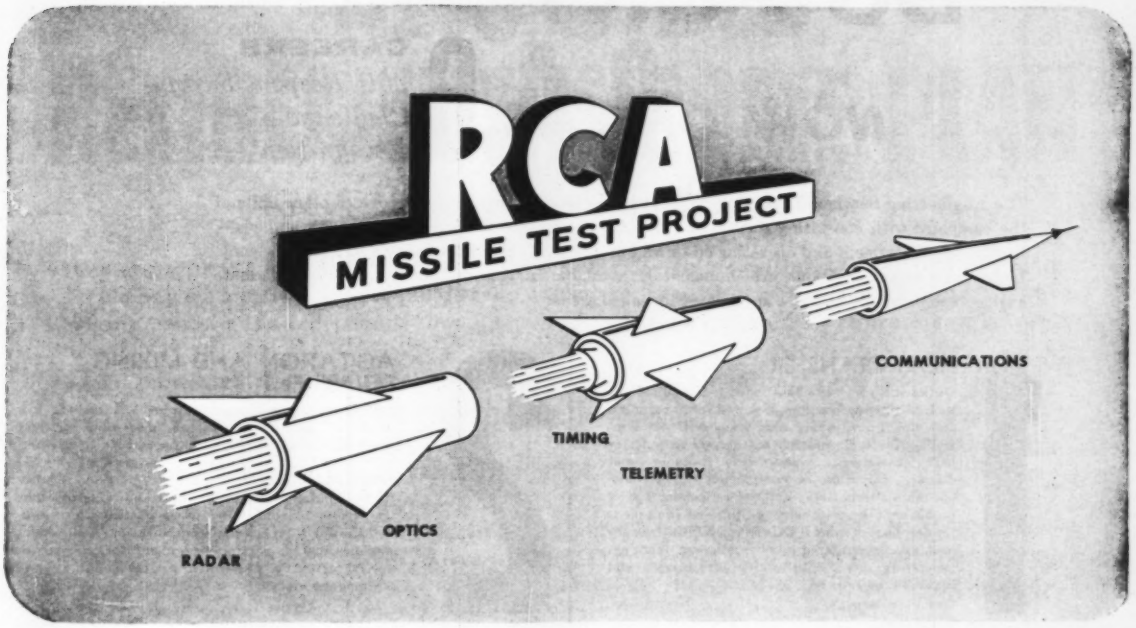


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**RCA Service Company, Inc.**
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Duties include: trouble-shooting on equipment, such as pipe line reactors, fluidized solids reactors, and film driers, where heat transfer is one controlling factor; selection of equipment, such as heat exchangers, evaporators, furnaces, and driers; evaluation of equipment to determine optimum alternatives; and theoretical analysis of problems in heat transfer in proposed equipment for new applications. Other typical heat transfer problems encountered involve reboilers, inert gas generators, direct fired production furnaces, and indirect fired retorts.

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The successful applicant for this position will be expected to have substantial industrial experience in mechanical development including one or more years in research, design, consulting, or application of drives, speed reducers, and other mechanical power transmission components and equipment. The specific functions of the position include selection, design, and trouble-shooting on speed controls and reducers, gearing, and bearings for equipment used in chemical processes and in fibre and film manufacturing and handling.

## 4 PUMPS AND FLUID MECHANICS

Desired qualifications will include extensive engineering knowledge of and familiarity with equipment used in the fluid mechanics field. Development, research, design, maintenance, or teaching experience with pumps, compressors, jets, and seals is desirable. Responsibilities of the position will involve selection of equipment, trouble-shooting, and consultation on fluid flow and mechanical design aspects of piping, pumps, jets, compressors, and seals. Duties include evaluation of available equipment and recommendations for equipment modification for special applications.

## 5 POWER

Position requires extensive practical power experience including operation and maintenance of industrial steam power plant facilities and equipment testing. Some experience in steam plant design and construction or in thermal insulation of process piping and equipment is desirable. Duties include: making economic evaluations and involved heat balances for complicated power systems; assisting in specification of power equipment and in selection of new facilities; and determination of causes of equipment malfunctioning and development of recommendations for corrections.

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Position requires substantial experience in selection and operation of heating, ventilating, air conditioning, and refrigeration equipment. Extensive knowledge of the following is desirable: Heating methods and systems, fans, building heat transmission, automatic controls, air cleaning devices, spray apparatus, sorbent materials, air duct design, exhaust and conveying systems, drying systems, health aspects of ventilation, piping and insulation, instruments and measurement, and investment and operating costs. Duties include consultation on evaluation and economic operation of such equipment.

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**Feb. 26-27-28-29 (Sun-Mon-Tues-Wed)**
*For appointment, please call* Mr. J. C. Costello, Jr.
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# ENGINEERS

# NEW 2-FOLD
# RETIREMENT INCOME PLAN

## for Aviation and Missile Engineers

It's natural that a long-time leader in aviation, like Republic—with many firsts to its credit—should be a leader, too, in providing for the welfare of its staff. Right in line with this forward-looking policy is the remarkable new Republic Retirement Income Plan. Here is how it works:

**PART 1** *is a basic Retirement Income plan paid for* entirely *by Republic Aviation.*

**PART 2** *is a cooperative effort. It is completely optional. But if an engineer wishes to increase his retirement fund, by making a small monthly payment, Republic will* MORE THAN MATCH *his contribution.*

Take the case of a hypothetical engineer who joins Republic on January 1st, 1956, averages $8,000 a year for 15 years; then retires aged 65. If he elected PART 2 of the plan, he will have a total *monthly retirement income of $225.80,* including his social security. For this he himself will contribute *only $8.50 a month* to the Republic Retirement Income Plan.

Of course, the MORE YOU EARN, the HIGHER your Retirement Income will be. And Republic pays a top salary scale in the industry.

### ...RETIREMENT PLAN JUST ONE OF MANY PLUS FACTORS POINTING TO A REPUBLIC CAREER

**FIRST** — there's the interest and prestige of working for a pioneer in aircraft design, creator of such famous planes as the F-84 Thunderjet, the F-84F Thunderstreak, RF-84F Thunderflash and XF-84H. (Soon to be followed on the production line by the new F-103, F-105 and RF-105.)

**SECOND** —the company is expanding sharply, providing frequent opportunities for able men to advance. In fact a $12,000,000 increase in the Research and Development Program has just been announced.

**THIRD** —an All-Expense Paid Relocation Plan for qualified engineers living outside the New York City and Long Island areas, which makes it easy to move to Republic. Other liberal benefits: Life, Accident and Health Insurance; Hospital-Surgical Benefits for the whole family; educational aid covering ⅔ the cost of collegiate and graduate study.

Serve your own best interests. Make full inquiries into the many advantages of joining Republic now, not the least of which is living on Long Island—the Playground of the East.

***Important engineering positions are now open at all levels:***

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## REPUBLIC AVIATION

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**MISSILES**
**Administrative Engineer, Mr. Robert R. Reissig**
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## ENGINEERING EDITOR

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Ideally, the man has an engineering degree (preferably Mechanical Engineering) plus a few years in industry, preferably dealing with engineering materials. While not necessarily a trained writer, he knows how to—and likes to—write clearly, accurately and interestingly.

If you meet these specifications, please write. Include education, work experience, age, military status, references and salary expected. Include samples of your published writings, if any. Address:

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## ENGINEERS
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These positions offer an opportunity to grow in the fields of ATOMIC POWER and AUTOMATION.

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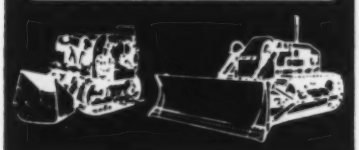

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*Index to*

## CLASSIFIED ADVERTISERS


AC Spark Plug Electronic Div.
General Motors Corp. ..... 162
Aerojet-General Corp.
Sub. General Tire & Rubber Co. ..... 147
Air Products, Inc. ..... 154
Bendix Aviation Corp., Pacific Div. ..... 151
Boeing Airplane Co. ..... 106
Chemstrand Corp. ..... 49
Convair, Div. of General Dynamics Corp. ..... 62, 92
duPont deNemours, E. I. & Co. ..... 149, 158
Eimco Corp. ..... 161
Esso Research & Engrg. Co. ..... 152, 154
Farnsworth Electronics Co. ..... 148
Garrett Corp., Rex Div. ..... 70
General Electric Co. ..... 145, 156, 163
General Motors Corp. ..... 148
Grumman Aircraft Engineering Corp. ..... 66
Hughes Research & Development Corp. ..... 64
Johns Hopkins University ..... 148
Lockheed Aircraft Corp. ..... 153
Lockheed Missile Systems Div. ..... 156
Los Alamos Scientific Laboratory ..... 161
Martin Co. ..... 82
Melpar, Inc.,
Sub. of Westinghouse Air Brake Co. ..... 80
Motorola Research Laboratory ..... 163
N. R. K. Mfg. & Engrg. Co. ..... 146
National Cash Register Co. ..... 150
National Carbon Co.
Div. Union Carbide & Carbon Corp. ..... 144
North American Aviation (Inc.) ..... 100, 140
Pennsylvania State University ..... 162
Phillips Petroleum Co. ..... 163
Pittsburgh Consolidation Coal Co. ..... 146
Pratt & Whitney
Div. United Aircraft Corp. ..... 76, 84
Radio Corp. of America ..... 157
Reaction Motors (Inc.) ..... 144
Remington Rand Univac
Div. Sperry Rand Corp. ..... 155
Republic Aviation Corp. ..... 159
Sandia Corp. ..... 50
Sperry Products, Inc. ..... 143
Thompson Products, Inc. ..... 152
Westinghouse Bettis Plant ..... 151



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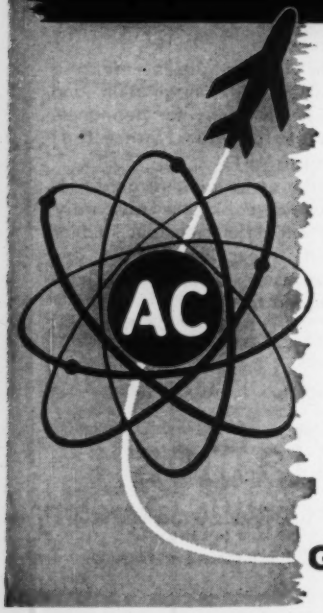


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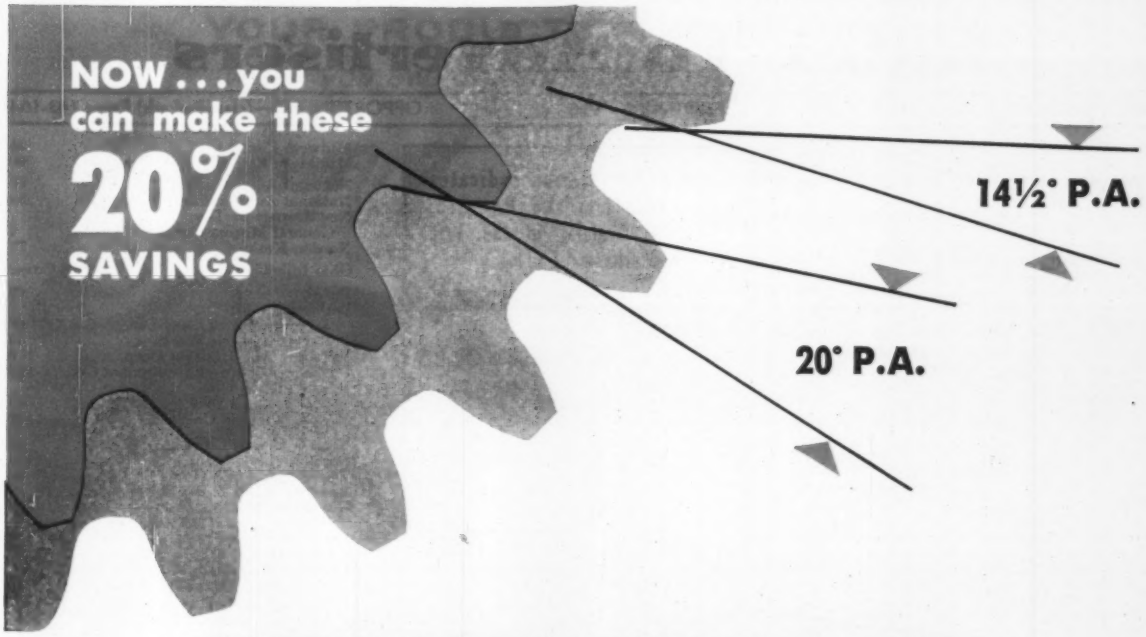


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|---|---|---|---|---|
| | Pinion | Gear | Pinion | Gear |
| Pitch Diam. | 2" | 8.4" | 1.66" | 7.00" |
| Center Distance | 5.200 | | 4.333 | |
| Weight | 1 lb. | 7½ lbs. | ¾ lbs. | 5 lbs. |
| List Price | 1.95 | 8.65 | 1.70 | 6.70 |

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# Index To Advertisers




Acme Chain Corp. 47
*Air Preheater Corp. 131
Ajax Flexible Coupling Co. 58
All American Tool & Mfg. Co. 87
*Allegheny Ludlum Steel Corp. 13
Allen-Bradley Co. 89, 90
*American Blower Corp.
Div. American-Standard 2
*American Brass Co. 23
American Felt Co. 127
ASME Publications 114, 136
Amplex Div.
Chrysler Corp. 170
*Armstrong Machine Works 128
*Associated Spring Corp. 103
Aurora Pump Div.
New York Air Brake Co. 61
Automatic Sprinkler Corp. of America 69

*Babcock & Wilcox Co. 2nd Cover
*Bailey Meter Co. 10
Bell Telephone Laboratories 165
*Bin-Dicator Co. 86
*Blaw-Knox Co.
Grating Dept. 59
Pipe Hangers 78
Power Piping 129
Boston Gear Works 167
Bridgeport Thermostat Div.
Robertshaw-Fulton Controls Co. 54
Bruning, Chas., Co. 21, 97
*Buffalo Forge Co. 12
Bundy Tubing Co. 133
Bunting Brass & Bronze Co. 79

Char-Lynn Co. 132
Chicago Rawhide Mfg. Co. 105
Cincinnati Gear Co. 74
Clearprint Paper Co. 142
*Cleaver-Brooks Co.
Boiler Div. 135
*Columbia-Geneva Steel Div. 6, 7, 139
*Combustion Engineering (Inc.) 104
Cone-Drive Gears Div.
Michigan Tool Co. 45
*Consolidated Chimney Co. 63
Copperweld Steel Co. 3
Crane Co. 122
Crane Packing Co. 81
Cunningham, M. E., Co. 87

Denison Engineering Co. 22
*Detroit Stoker Co. 98
Diamond Chain Co. (Inc.) 30
Dravo Corp.
Heating Dept. 101
Tri-Lok 60
Dresser Industries (Inc.)
Roots Connersville Blower Div. 31
Drop Forging Association 51
Dudek & Bock Spring Mfg. Co. 86
Duff-Norton Co. 65
DuMont, Allen B., Labs. (Inc.) 120

Edward Valves (Inc.)
Sub. Rockwell Mfg. Co. 4, 5
*Elastic Stop Nut Corp. of America 71
Ellison Draft Gage Co. 85
*Erie City Iron Works 35

Fafnir Bearing Co. 33
Farrel-Birmingham Co. 113


**The asterisk indicates that firm also has product catalog in the 1956 Mechanical Catalog**

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*Published Annually*

*Flexitallic Gasket Co. 41
*Flexonics Corp. 83
Ford Instrument Co.
Div. Sperry Rand Corp. 96
Formica Co. 125
*Foster Wheeler Corp. 8, 9
*Foxboro Co. 28, 29
Frick Co. 80

*Garlock Packing Co. 20
General Radio Co. 99

Hagan Corp. 123
Hays Mfg. Co. 67
*Homestead Valve Mfg. Co. 34
*Hyatt Bearing Div.
General Motors Corp. 14, 15
*Hydropress (Inc.) 95

International Nickel Co. 36
Irving Subway Grating Co. 39

Jeffrey Mfg. Co. 91
Jenkins Bros. 42
*Johns-Manville 32

Kellogg, M. W., Co. 109
*Kewanee Boiler Div.
American-Standard 121
Kollmorgen Optical Corp. 136
Koppers Co.
Fast's Coupling Dept. 102

Lake Shore (Inc.)
Lake Shore Engineering Div. 130
Lefax 164
LimiTorque Corp. 53
Linear (Inc.) 134
Link Aviation (Inc.) 75
*Link Belt Co. 16
Lovejoy Flexible Coupling Co. 67

Marsh Instrument Co.
Affil. James P. Marsh Corp. 117
*Mercoid Corp. 130
Midwest Piping Co. 25
Miniature Precision Bearings (Inc.) 60

National Acme Co. 52
*National Airoil Burner Co. 53
New Departure Div.
General Motors Corp. 1
Norden-Ketay Corp. 77

Ohio Injector Co. 3rd Cover

*Pangborn Corp. 46
Perfection Gear Co.
American Stock Gear Div. 66
Philadelphia Gear Works 53
Pittsburgh Lectrodryer Corp. 116
Pittsburgh Piping & Equipment Co. 112
*Porter, H. K., Co.
W-S Fittings Div. 48
Powell, William, Co. 126

Read Standard Corp. 44
*Republic Flow Meters Co. 124
Research-Cottrell (Inc.) 60
Revere Copper & Brass (Inc.) 18, 19
Robertshaw-Fulton Controls Co.
Div. Bridgeport Thermostat 54
Rockford Clutch Div.
Borg-Warner Corp. 57
*Rockwell Mfg. Co.
Nordstrom Valve Div. 119
Roots-Connersville Blower Div.
Dresser Industries (Inc.) 31
Rust-Oleum Corp. 11

Snap-Tite (Inc.) 115
*Southwest Products Co. 132
Spraying Systems Co. 85
Stephens-Adamson Mfg. Co. 88
Stewart-Warner Corp.
Alemite Div. 169
Stock Equipment Co. 70
Streeter-Amet Co. 136
*Syntron Co. 132

*Taylor Forge & Pipe Works 72, 73
*Taylor Instrument Cos. 108
*Terry Steam Turbine Co. 17
*Tennessee Coal & Iron Div. 6, 7, 139
Thomas Flexible Coupling Co. 75
*Timken Roller Bearing Co. 4th Cover

U. S. Hoffman Machy. Corp. 141
United States Graphite Co.
Div. Wickes Corp. 27
*United States Steel Corp. 6, 7, 139
*United States Steel Export Co. 6, 7, 139

Vard (Inc.) 94
*Vogt, Henry, Machine Co. 110
*Voss, J. H. H., Co. 134

Waldes Kohinoor (Inc.) 111
Walworth Co. 107
Wheeler, C. H., Mfg. Co. 24
*Wickes Boiler Co.
Div. of Wickes Corp. 93
Wiegand, Edwin L., Co. 74
Winzeler Mfg. & Tool Co. 26
Wisconsin Motor Corp. 61
Wollensak Optical Co. 68

*Yarnall-Waring Co. 37
Yoder Co. 118


CONSULTING SERVICE . . . Page 166

Black & Veatch
Electrical Testing Labs.
Gilbert Associates (Inc.)
Harza Engineering Co.
Jackson & Moreland (Inc.)
Kellogg, M. W., Co.
Kendall, George H.
Kuljian Corp.
Loftus, Peter F., Corp.
Lummus Co.
Mast Development Co.
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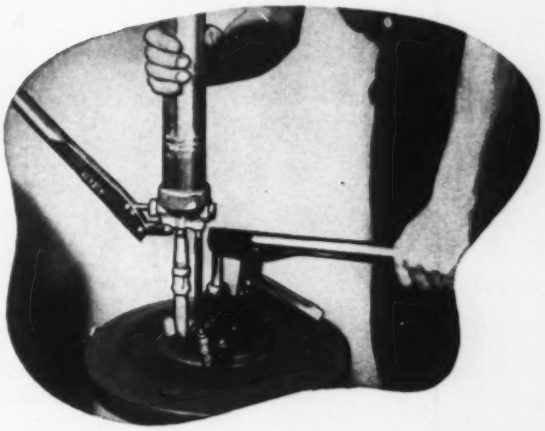
*when you switch lubrication methods from*

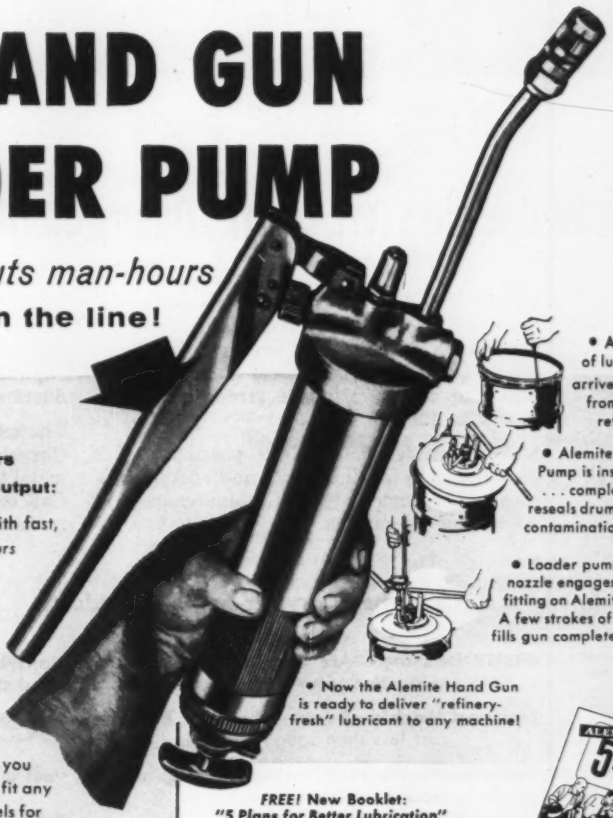
# *Backward* to *Forward!*



# ALEMITE HAND GUN WITH LOADER PUMP

*reduces downtime...cuts man-hours*

**...saves right down the line!**





• A drum of lubricant arrives—fresh from the refinery.



• Alemite Loader Pump is inserted . . . completely reseals drum against contamination.



• Loader pump nozzle engages fitting on Alemite gun. A few strokes of pump fills gun completely.

• Now the Alemite Hand Gun is ready to deliver "refinery-fresh" lubricant to any machine!

**Why more and more plant managers look to Alemite lubrication for greater output:**

Time studies prove it! Refilling hand grease guns with fast, efficient Alemite Loader Pumps saves you *15 man-hours* for every 400-pound drum of lubricant, compared with loading the old-fashioned hand-and-paddle way!

You eliminate the cost, mess and fire hazard of "oil-room" spillage. With Alemite equipment you can *transfer, load and apply* lubricant that you know is *completely* free of dirt, grit or abrasives. Machine-hours are saved, too! With better lubricated bearings, machines stay new longer!

Alemite can furnish a hand gun of correct capacity for your operation—from 8 ounces to 2 pounds. And you get the pressure you need—up to 15,000 pounds! There is an Alemite Loader Pump to fit any standard lubricant container you normally use—stationary models for 100-lb. and 400-lb. drums; portable models for 25-lb. and 35-lb. pails.

Ask your nearest Alemite supplier for full details.

***FREE!* New Booklet:**
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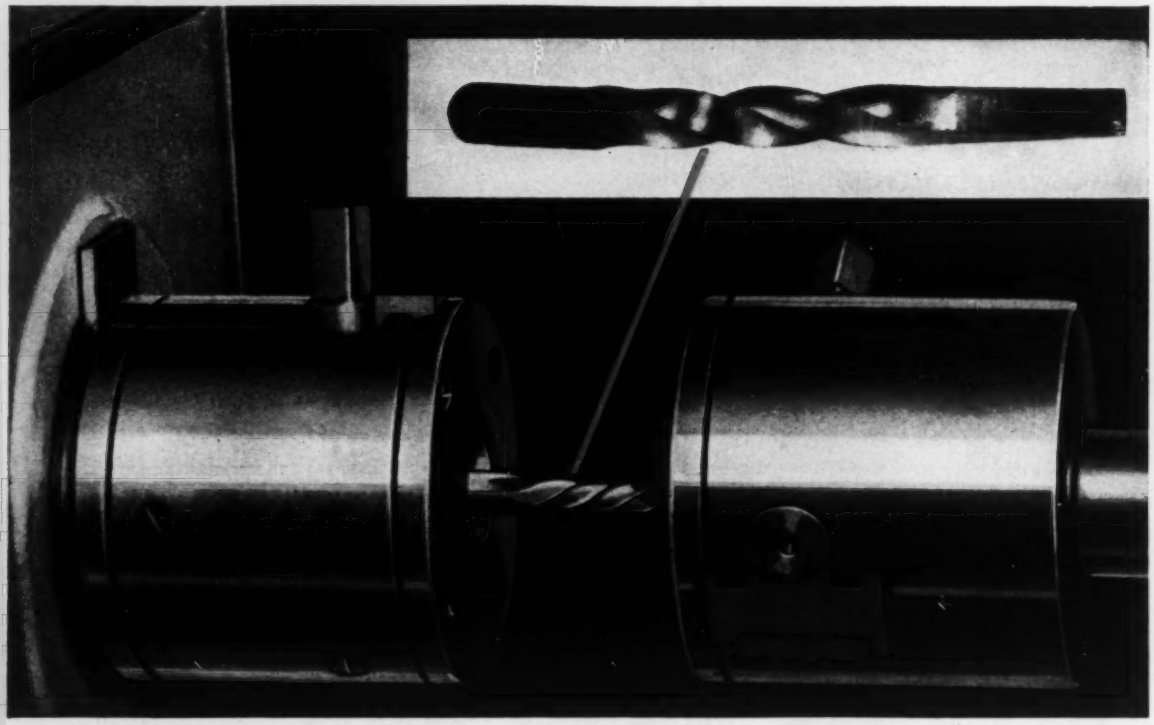
# IN POWDER METALLURGY . . . IT'S AMPLEX



New STEEL OILITE'S unusual ductility is demonstrated in this photo of a typical torsion test. This revolutionary material was developed by Chrysler for applications requiring extreme ruggedness.

## *NEW* Ductile STEEL OILITE® Opens Up New Uses for Powder Metals

STEEL OILITE is a new and revolutionary Chrysler developed die-pressed powder metal with ductility and strength in the range of low carbon steel (elongation values up to 15%; tensile strength from 35,000 to 120,000 PSI).

Makes considerable savings possible for countless new applications; one customer reported savings of 96%. Eliminates most machining operations.

STEEL OILITE may be hardened, machined and staked using conventional methods. Developed by Chrysler-Amplex engineers, STEEL OILITE has been production and field tested for over 18 months.

The engineering facilities of Amplex and Chrysler are unmatched in the powder metal industry. They are ready to help you. Call or write today for STEEL OILITE information. Ask for Bulletin STM-54.

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**OILITE Bearings**—Are Chrysler engineered. Standard bearings are available from stock in most cities. Also cores, bars, plates, discs and strips.

**Finished Machine Parts**—Broad range of ferrous and non-ferrous metals and alloys. Frequently cost less than rough castings.

**Permanent Metal Filters**—In bronze, stainless steel and other metals. For filtering, diffusing, separating, etc.

*Only Chrysler makes OILITE*

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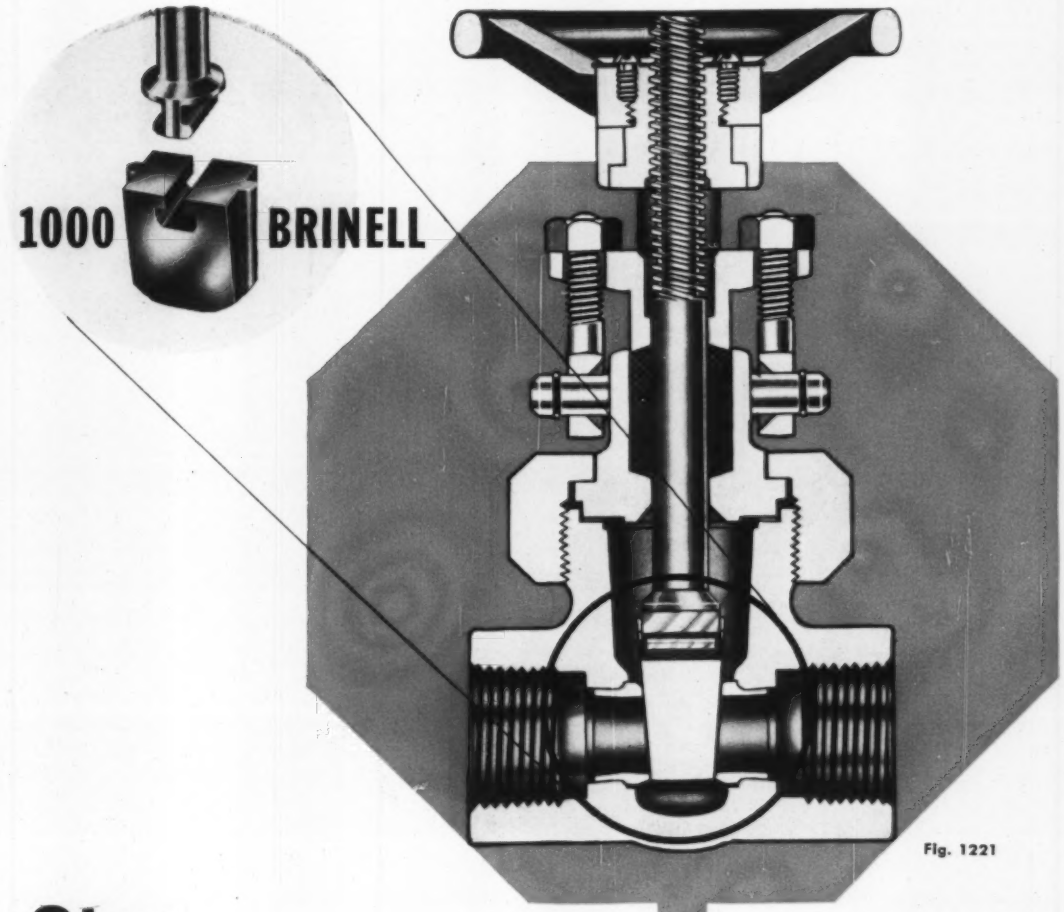



Fig. 1221

# Stop Galling with the hardest valve wedges you can buy

OIC VALVES

FORGED & CAST STEEL,
BRONZE & IRON,
LUBRICATED PLUG VALVES

### Highly resistant to erosion and corrosion

Here's a wedge as hard as flint . . . so hard that it's undamaged by pipe cuttings, scale or grit. It's the only trim we know of which will successfully withstand the simultaneous attack of the three valve-destroying agents—corrosion, erosion, galling. This wedge is *13% chrome stainless steel hardened up to 1000 Brinell.*

Specify the OIC 1221 gate or 1621 globe where you need the extra rugged nature of forged steel. They are recommended for steam service up to 800°F...oil service up to 1000°F. Or, use these same valves for hydraulic service up to 2000 lbs.

Write for Form 195 for specifications on the OIC forged steel line.

**THE OHIO INJECTOR COMPANY**
**WADSWORTH, OHIO**

# Trepans and bores 32-foot gun barrels—TIMKEN® bearings keep huge spindle accurate

THIS Baldwin-Lima-Hamilton NILES A36B boring lathe has a finished weight of 235,680 lbs. and an overall length of 90 feet. It took one year to build and was specifically made to trepan and bore gun barrels as long as 32 feet. To give its huge spindle high accuracy and stability—despite heavy radial and thrust loads and speeds up to 1000 R.P.M.—the spindle was mounted on Timken® tapered roller bearings.

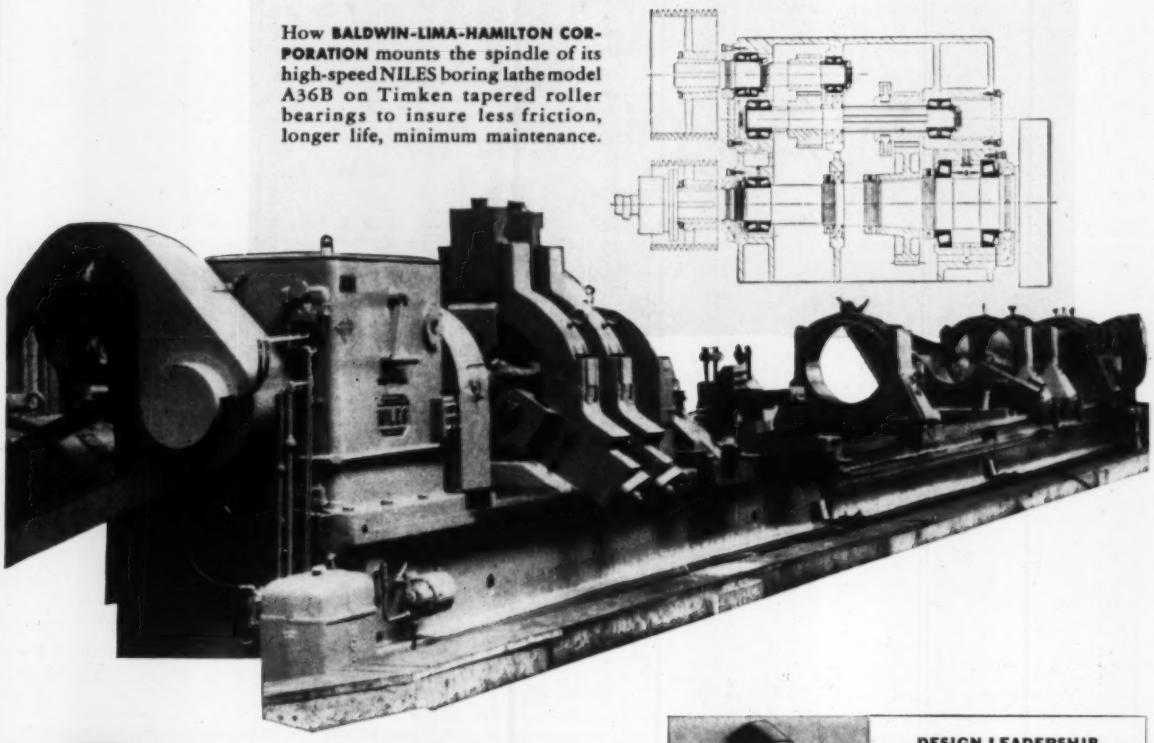
Timken bearings are tapered in construction to take the heavy radial *and* thrust loads this huge spindle gets. Full line contact between rollers and races provides maximum capacity. They maintain spindle precision and accurate gear mesh.

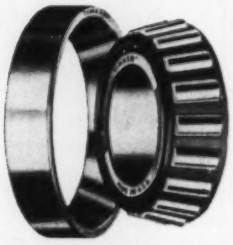
Timken bearings reduce wear because they practically eliminate friction. That's because they're designed by geometrical law to have true rolling motion and made with extreme accuracy so they live up to their design. And they're made of steel we make ourselves: we're the only American bearing maker who takes this extra quality precaution.

Specify Timken bearings for the machinery you build or buy. Always look for the trade-mark "Timken" on every bearing. The Timken Roller Bearing Company, Canton 6, Ohio. Canadian plant: St. Thomas, Ont. Cable address: "TIMROSCO".

*This symbol on a product means its bearings are the best.*

How **BALDWIN-LIMA-HAMILTON CORPORATION** mounts the spindle of its high-speed NILES boring lathe model A36B on Timken tapered roller bearings to insure less friction, longer life, minimum maintenance.

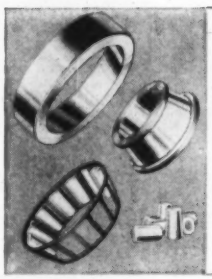




**TIMKEN**

TRADE-MARK REG. U. S. PAT. OFF.

*TAPERED ROLLER BEARINGS*



**DESIGN LEADERSHIP**

The first Timken tapered roller bearing was produced in 1898. Since then the one-piece multiple perforated cage, wide area contact between roller ends and ribs, and every other important tapered roller bearing improvement have been introduced by The Timken Roller Bearing Company.

The Timken Company leads in: 1. advanced design: 2. precision manufacture; 3. rigid quality control; 4. special analysis steels.

NOT JUST A BALL ○ NOT JUST A ROLLER ▭ THE TIMKEN TAPERED ROLLER ▭ BEARING TAKES RADIAL ◫ AND THRUST →◫← LOADS OR ANY COMBINATION →✳←